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NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

28641 (ANL-6543) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, JANUARY–MARCH 1962. (Argonne National Lab., Ill.). June 1962. Contract W-31-109-eng-38. 219p.

Additional experiments conducted on nitridation of irradiated U-fissium fuel pins revealed that irradiation does not greatly affect the nitridation rate at 300°C. In skull-reclamation development, a phase separation common to both the blanket- and skull-processes was investigated in which a 50% Mg–Zn supernatant solution was removed from precipitated U metal. In most runs the supernatant phase was removed with negligible U entrainment. The reduction rate of ZrO by Zn–Mg solution under skull-recovery process conditions was found to be lower than that of U oxides. It may be possible in this process to effect some Zr separation by limiting the reduction time to that necessary for U. Methods of processing EBR-II fuels are being investigated to establish methods of separating rare earths from Pu. Development work on preparation of UC by addition of C to U dissolved in liquid metal media showed that the limited addition of alkali metals improves C wetting and the reaction rates. Analysis of UC prepared for fabricability tests showed high C-to-U ratios and high O_2 contamination; procedure and equipment improvements are being made. Studies are in progress to evaluate the compatibility of various materials with the liquid metal-salt systems contemplated for reactor fuel reprocessing. Tungsten appears to have high corrosion resistance to Zn–Mg solutions and the flux systems used in the skull-reclamation process. A W-30% Mo alloy also showed excellent corrosion resistance to skull-reclamation processing systems in demonstration runs. A status summary of the EBR-II fuel cycle facility is given. Fundamental studies are being made in support of the pyrometallurgical process. The solubilities of Pr and Be in liquid Zn and the solubility of U in liquid In were measured. In recrystallization separation studies, the coprecipitation of Ru by U when the U is precipitated from Mg–Zn solutions was measured. The codistribution coefficients of U, Pu, Sr, and Cs between Pb and Zn were also measured along with the mutual solubilities of Pb and Zn above 650°C. Laboratory development work continued on the direct fluorination process for recovery of U and Pu from oxide fuels. Conclusions concerning Pu removal from inert solids are included. Engineering-scale studies of the direct fluorination of U indicate that high F_2 efficiency can be obtained by off-gas recycle while holding recycle O_2 to a minimum. Studies were conducted on a fluidization volatility scheme for recovering enriched U from low U–Zr alloy fuels. Results of experiments conducted in a $1\frac{1}{2}$-in.-dia fluid-bed reactor coupled with a similarly sized down-flow filter bed, showed that holdup of U in the inert solids becomes constant upon re-use of the bed. Additional studies on the conversion of zirconium tetrachloride vapor to dense solid oxide by reaction with steam in a fluid-bed reactor were carried out. Efforts to improve reaction efficiency are reviewed. Experimental work on the two-step fluid-bed process for converting UF_6 to UO_2 showed excessive fines being formed in some cases; however, it is believed that these can be combined with the main process streams for further reaction to the dioxide. Progress in a program to determine thermodynamic data on compounds of interest in high-temperature chemistry is reported. Information concerning the combustion of Cd, Mg, Ti, Hf, V, Nb, Ta, and U in F_2 is included. In reactor safety studies, an experimental program to determine the reaction rates of molten reactor fuels and cladding metals with water is continuing. Research on energy conversion by a regenerative emf cell and the thermoelectric effect is reported. Work in progress on Yb^{176}, Sb^{121}, and Mo^{98} neutron capture is reviewed along with work on reactor decontamination and routine operations. (J.R.D.)

28642 (BMI-158(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY, 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). June 1, 1962. Contract W-7405-eng-92. 98p.

Research and development activities are reported on reactor materials and components, fuels, preparation of UO_2 single crystals, radioisotope and radiation applications, coated particle fuel materials, bonding processes, creep-rupture of SAP alloys, fuels for MGCR, fabrication of UO_2–ZrO_2 systems, and Be cladding of UO_2. (J.R.D.)

28643 (LAMS-2593) A CALCULATION TO SIMULATE THE UNDERGROUND BERNALILLO SHOT. Robert R. Brownlee (Los Alamos Scientific Lab., N. Mex.). Aug. 1961. Contract W-7405-eng-36. 39p.

Detailed calculations were undertaken in an attempt to explain some post-shot observations of the underground Bernalillo shot. A procedure was developed to calculate with a one-space dimensional code both the flow of energy up and down the hole and the energy loss into the walls of the hole. The temperature and pressure histories are given for times up to 24.9 milliseconds, and diagrams of the calculated cavity at various times are also given. Apparently, the pressure and temperature at the top of the hole were much smaller than those calculated. This was probably due to the fact that the hole became blocked, 381 feet below the top, at a very early time. If so, the energy would be very efficiently contained, and the losses into the wall would be much greater than calculated. (auth)

28644 (MLM-1125) MOUND LABORATORY MONTHLY PROGRESS REPORT FOR OCTOBER 1961. J. F. Eichelberger (Mound Lab., Miamisburg, Ohio). Oct. 31, 1961. Contract AT(33-1)-Gen-53. 27p.

Work directed toward development of improved plastics is reported. Flow data were obtained on batches of an asbestos-filled diallylphthalate molding compound. An adhesive catalog showing optimum properties is being prepared. Film-cast epoxy systems showed good flexibility; however, sudden flexing causes cracks. Properties of experimental adhesive formulations are tabulated. In other work processes being developed for separating and purifying radioelements and sources of supply are being evaluated. In earlier work, Ra^{223} was separated by precipitating Ac with NH_4OH followed by evaporation of the filtrate and redissolution in HNO_3. This solution was made basic and passed through an anion exchanger. The effectiveness of this procedure was evaluated using tracer Ac^{227} in a simulated separation. The yield of Ra^{223} was lower than desired and alternative methods are being examined. Development of Be space radiation films for filtering out the lower energy gamma and x radiation is reported. Techniques for casting plastics for use as backing for Be depositions are being investigated. Data and information concerning casting of films on polyethylene, glass, and water are given. Several techniques tried for evaporating Be are also reported. In analytical methods development, techniques for determination of Pu and Fe were investigated. A current controller for use in calorimetry was developed which constantly maintained a 100-Ma heater current to within 2 ppm for 8 hrs. The physical properties of Pu-Ce-Co systems were determined at 435 to 800°C. Phase studies of Au-Pu are reported, and preparation of Pu-bearing glasses is described. (J.R.D.)

28645 (NP-11960) ANNUAL REPORT [ON NUCLEAR RESEARCH], APRIL 1960 - MARCH 1962. (Tokyo Univ. Inst. for Nuclear Study). Mar. 31, 1962. 70p.

Research progress on low-energy physics, high-energy physics, cosmic radiation (air showers), cosmic radiation (balloon studies), theoretical physics, and chemistry is reported. (M.C.G.)

28646 (ORNL-2274(Pts.1-5)) AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1957. (Oak Ridge National Lab., Tenn.). July 11, 1957. Contract W-7405-eng-26. 327p.

Activities in a program directed toward the design, construction, and operation of the Aircraft Reactor Test (ART) are reported. Progress is reported in the areas of aircraft reactor engineering, chemistry, metallurgy, radiation damage, fuel reprocessing, critical experiments, and reactor shielding. (J.R.D.)

28647 (ORNL-2340(Pts.1-5)) AIRCRAFT NUCLEAR PROPULSION PROJECT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1957. (Oak Ridge National Lab., Tenn.). Sept. 12, 1957. Contract W-7405-eng-26. 357p.

Activities directed toward development of a circulating-fuel type reactor are reported. The design, construction, and operation of the Aircraft Reactor Test (ART) are the major objectives which are discussed. This system includes a 60-Mw circulating-fuel reflector-moderated reactor. Operation of the system will be for the purpose of determining feasibility and for studying problems associated with a high-power, circulating-fuel reflector-moderated aircraft reactor. Progress is reported on aircraft reactor engineering, chemistry, metallurgy, radiation damage, and reactor shielding. (J.R.D.)

28648 (RM-3204-PR) THE RESPONSE TIME OF THE LOWER IONOSPHERE TO A PULSE OF IONIZATION. R. E. LeLevier (RAND Corp., Santa Monica, Calif.). Aug. 1962. Contract AF49(638)-700. 40p.

A theoretical discussion of the response of the ionosphere to a pulse of ionization is presented. It is known that both the local air chemistry and the level of ambient ionization affect the lifetime of free electrons in the ionosphere. The model for the air chemistry used assumes a standard air mixture for which O_2^- is the dominant negative ion. Day and night environments are discussed. For illustrative purposes, the recovery characteristics of x-ray induced ionization from high altitude nuclear explosions were considered. A suggestion is made for using a low yield, high altitude nuclear explosion as an x-ray source of known characteristics. This would permit the factoring of the properties of the ionosphere from those of the source. (auth)

28649 (SCR-500) CIVILIAN APPLICATION RELEASES THROUGH 1961. Bibliography. (Sandia Corp., Albuquerque, N. Mex.). June 1962. Contract [AT(29-1)-789]. 73p.

Approximately 1206 references are given to reprints and monographs, technical reports, development reports, technical memoranda, manuscript releases, miscellaneous papers, and engineering materials published from 1953 through 1961. (P.C.H.)

28650 (TID-3043(Rev.2)) BIBLIOGRAPHIES OF INTEREST TO THE ATOMIC ENERGY PROGRAM. James M. Jacobs, Naomi K. Smelcer, and Hugh E. Voress, comps. (Division of Technical Information Extension, AEC). Mar. 1962. 302p.

References (2470) on various aspects of atomic energy and allied subjects are given to bibliographies and literature surveys published as reports and in open literature. References are arranged alphabetically by the issuing agency. Subject, author, and report number availability indexes are included. (P.C.H.)

28651 (TID-16338) RADIOISOTOPES RESEARCH, DEVELOPMENT, AND RELATED ACTIVITIES. Quarterly Progress Report No. 14, March 15 - June 15, 1962. (Chicago. Univ. Labs. for Applied Science). July 1962. Contract AT(11-1)-712. 42p. (LAS-SR-161-47)

Efforts during the period were devoted primarily to theoretical studies and report preparation. Investigations concerning the moisture probe equivalence factors were continued. These factors can be used in calculations of the water or H equivalent of non-hydrogenous element effects on moisture probe readings. Factors relative to water were calculated for H, C, Al, Ca, Fe, Mg, N, O, K, Si, and Na. In other work, reports were prepared and are included concerning notes for ASTM Tentative Standards on radioactivity-based density and moisture gages. In these methods, density is determined by gamma backscatter, and moisture is determined by fast neutron moderation. The status of reports already prepared and in preparation is reported. (J.R.D.)

28652 (TID-16374) RADIATION STABILITY OF ORGANIC FLUIDS. Progress Report, January 1, 1962 — March 31, 1962. R. O. Bolt, M. L. Burrous, J. G. Carroll, K. L. Hall, M. A. Sweeney, and W. W. West (California Research Corp., Richmond). June 15, 1962. Contract AT (04-3)-248. 55p.

The study of the effects of radiation type on coolant de-

composition was the principal activity during this report period. Progress was made with both linear energy transfer (LET) (helium ion and gamma) and Susie (fast neutron and gamma) programs. The dosimetry of mixed radiation fields played an increasingly vital role in the Susie reactor work. Considerable supporting research was also devoted to analytical methods for the separation and identification of radiolysis products. Total gas G-values and the yields of unsaturated gases were found higher for irradiations with 40-Mev He ions than for exposures to Co^{60} gamma rays. If unsaturates contribute to film formation, these data suggest that LET plays a part in this process. In Susie work on the fast neutron effect, polyphenyl samples are exposed in stainless steel capsules placed in a heated canister adjacent to the Susie reactor core. Samples are exposed to two different radiation environments. The neutron portion of the energy absorbed is about 75% in one case and about 10% in the other. Postirradiation inspections include gas analysis and G_{-M_5} about 50 samples were analyzed. The total energy absorbed in samples exposed to the Susie reactor was measured by isothermal calorimetry. Dose rates are determined directly in terms of energy absorbed in different materials. Then, if the approximate neutron energy spectrum is known, the division of energy into that from neutrons and that from gammas can be calculated. The fundamental theory by which this division of energy is calculated was examined. The role of the neutron energy spectrum in these calculations was also evaluated. Preliminary mapping with calorimeters was conducted in representative radiation positions in Susie. Dose rates of about 0.020 w/g (7.2×10^6 rads/hour) prevail in terphenyls. The values at hand are adequate for estimating radiation doses, although their precision is not good enough for calculation of the division of energy between neutrons and gammas. Both the precision and the accuracy of the calorimeter measurements of total heat were improved. Extensive further monitoring using calorimeters and threshold foils is planned. (auth)

28653 (WT-921) BLAST EFFECTS ON TREE STAND. W. L. Fons and Theodore G. Storey (Forest Service. Div. of Fire Research). Mar. 1955. Project 3.3 [of] OPERATION CASTLE. 43p.

Data are presented on graded general damage to tree stands from a high yield weapon of long positive phase duration time and damage from a medium yield weapon with shorter positive phase duration time. Ground level pressure measurements 2000 ft into a tree stand showed no attenuation in peak static overpressure. It was not possible to assess the stand influence on blast damage because of non-uniformity of stand composition. Observed damage from the two weapons of different yields compare favorably with isodamage curves prepared for broadleaf stands. Damage in broadleaf stands was principally limb breakage and defoliation with occasional breakage of the main stem or uprooting. The type of damage was similar for moderate- and high-yield weapons. (C.H.)

28654 (WT-1339) THERMAL EFFECTS ON CELLULOSIC MATERIALS. W. L. Fons, C. P. Butler, and H. D. Bruce (Forest Service. Div. of Fire Research). Mar. 12, 1959. Project 8.2 [of] OPERATION REDWING. 28p.

Cellulosic materials were exposed to thermal radiation to determine minimum thermal-ignition energies for kindling fuels and depth of char in wood as a check on equations developed from laboratory data. Test specimens of alpha-cellulose paper of various thicknesses, densities, and carbon contents; six common kindling fuels (cotton denim, rayon cloth, newspaper, pine needles, dry grass, and corrugated fiberboard); and three species of wood (maple, willow, and balsa) were exposed to the radiation from Burst Cherokee. Because the burst was not directly over planned target zero, the depths of char of the wood specimens were without significance. Data were obtained that permitted an estimate of the critical ignition energy for newspaper, pine needles, and ten of the black papers. The primacord technique of triggering a mechanism first before burst time was entirely successful and should prove useful in a wide variety of applications. (auth)

28655 (JPRS-14284) ATOMIC BIOLOGICAL CHEMICAL WARFARE AND DEFENSE. Translation of "Atomska Biloloshka Hemiska Orushja i Zashtita," Zagreb, 1960. 540p.

Translations are presented of 16 Soviet articles covering various aspects of atomic, biological, and chemical warfare agents and means of defense against each. Topics discussed include nuclear reactions, reactor design, controlled thermonuclear reactions, nuclear explosives and nuclear weapons, radiological detection and dosimetry, biological effects of radiation, internal contamination by radioisotopes, peaceful uses of nuclear energy, the production and properties of microbial aerosols, uses of microorganisms and their products as bacteriological warfare agents, the detection and identification of bacteriological warfare agents and protective measures against them, the causes of plant diseases and means of protection, chemical warfare agents with emphasis on organophosphorus compounds and nerve gases, medical aspects of the effects of modern war gases, and means of protection against chemical warfare agents. (163 references.) (C.H.)

28656 THE NUCLEAR ENERGY LAW OF THE SOVIET-OCCUPIED ZONE OF GERMANY. Norbert Pelzer (Universität Göttingen, Ger.). Atomwirtschaft, 7: 340-5 (July 1962). (In German)

In March 1962, the new Atomic Law was enacted as basic law and contains the first comprehensive regulation of the use of atomic energy in East Germany. It consists of only 14 paragraphs and is divided into 8 sections: general regulations, organs for the application of atomic energy, protection areas, radiation protection, liability, penalty regulations, definitions, and concluding regulations. Before the enactment of this law, regulations covering the field of nuclear energy were enacted in a series of statutes concerned principally with radiation protection and organization. The international collaboration of the Eastern Zone is limited to the eastern bloc. (J.S.R.)

28657 THE PROCUREMENT OF NUCLEAR FUELS FROM THE UNITED STATES OF AMERICA. G. Heyne. Atomwirtschaft, 7: 350-2(July 1962). (In German)

The German Federal Government meets its needs for nuclear fuels primarily from the United States. This means that a number of American laws and regulations must be observed. As the American law does not permit private ownership, the procurement of fuels must be conducted on a government level, and the fuels obtained leased or rented to German firms concerned. The necessary applications, documents, notifications, and licensing procedures, as well as the transfer, transportation, and delivery of the fuels, are described in detail, and the pertinent authorities are tabulated. (J.S.R.)

28658 RADIOISOTOPES. PRETORIA, 1957. Publication No. 28. London, C.C.T.A./C.S.A., 1959. 233p. $6.25 (New York, International Publications Service).

The 41 papers presented at the conference on the use of radioisotopes in Africa south of the Sahara are compiled. Topics discussed include recommendations on the handling of radioisotopes, radioisotopes in cellular biology, atomic energy in agriculture, histological distribution and reten-

tion of lead, effects of Sr in monkeys, radiation sickness, instrumentation in the tropics, radioisotopes in industry, labeling techniques, quality testing and leak detection with radioisotopes, synthesis of labeled compounds, medical uses of radioisotopes, biological tracer studies, and protection policies. Separate abstracts have been prepared for three papers. (J.S.R.)

28659 HISTOLOGICAL DISTRIBUTION AND RETENTION OF LEAD, RADIOSULFUR, AND RADIOCALCIUM IN COMPACT BONE. J. Vincent. p.41-5 of "Radioisotopes. Pretoria, 1957." London, C.C.T.A./C.S.A., 1959. (In French)

The distribution of lead in compact bone was studied by histochemistry, and that of sulfur and calcium by autoradiography. The determination of the short-time distribution of calcium and lead showed the dynamics of bone calcification. Neither element was uniformly distributed, and both were deposited selectively in zones of rapid calcification. Study of S distribution showed that the constitution of the basic substance alters abruptly when it begins to calcify. The chronology of the Haversian modification was determined. Long time observations showed that at the end of six months the sulfur is still solidly incorporated in the bone. (J.S.R.)

28660 EFFECTS OF RADIOACTIVE STRONTIUM IN MONKEYS. A. H. Ward. p.47-54 of "Radioisotopes. Pretoria, 1957." London, C.C.T.A./C.S.A., 1957. (In English)

New results on the concentration of Sr^{90} in bone and on the excretion and retention of Sr^{90} following oral administration as determined in monkeys are reported. The bone concentration showed quite large fluctuations, and the delayed fall in blood count after low-dose injections indicated that it might be impossible to use blood tests for determining lethal doses of Sr^{90}. Tentative results on the tolerance levels showed the high toxicity of Sr^{90}. The general excretion pattern was similar to that of calcium. Even after two years there was a high retention of Sr^{90} in the monkeys. (J.S.R.)

28661 RISKS OF SICKNESSES CAUSED BY THE USAGE OF RADIOISOTOPES AND THE PRECAUTION MEASURES TO TAKE. A. Lebrun. p.55-88 of "Radioisotopes. Pretoria, 1957." London, C.C.T.A./C.S.A., 1959. (In French)

A general survey is made of the risks inherent in the use of radioisotopes and the safety precautions to be taken. The types of ionizing radiations and their reaction with matter are first described. The units of measurement and definitions are defined. The biological effect of radiation with a consideration of the types of radiation is discussed. The concluding sections review types of exposure, permitted doses, and radiological protection. (J.S.R.)

28662 INTERNATIONAL DIRECTORY OF RADIOISOTOPES. SECOND EDITION. PART I. UNPROCESSED AND PROCESSED RADIOISOTOPE PREPARATIONS AND SPECIAL RADIATION SOURCES. PART II. COMPOUNDS OF CARBON-14, HYDROGEN-3, IODINE-131, PHOSPHORUS-32 AND SULPHUR-35. (International Atomic Energy Agency, Vienna). June 1962. 740p. $9.00(IAEA). (STI/PUB/45)

Information is given on most radioisotopes and labeled compounds sold or distributed by the major suppliers in the world. Complete tables of radioisotopes, including unprocessed and processed isotope preparations, compounds of isotopes, and solid radiation sources for special applications are given. The most important current physical information is included, such as data on half lives and radiations. Isotopes are arranged alphabetically. A list of compounds labeled with C^{14}, H^3, I^{131}, P^{32}, and S^{35} is presented, and standard sources of the isotopes are included. Compounds of each isotope are arranged in alphabetical order by their most familiar names. Price quotations in local currency are converted into U. S. dollars to allow comparison. (P.C.H.)

28663 ROLE OF THE UNIVERSITY IN NUCLEAR TRAINING AND EDUCATION—REGULAR AND SPECIAL PROGRAMS. Glenn Murphy (Iowa State Univ., Ames, Iowa). Preprint Paper No. 61. New York, Engineers Joint Council, 1962. 10p.

The general problem of education and training in the nuclear field is broad and complex for it involves virtually every person in existence. The types of education required embrace a spectrum ranging from the dissemination of general public information on the proper role of nuclear science and engineering in modern living to the intricate and specialized development of the research scientist. The depth of training ranges from creating an awareness of nuclear energy to the development of special skills and understandings. Education in the field is a never-ending process. It begins in the primary school and continues throughout life. The university, government and non-profit research establishments, and industry have complementary roles in the educational process. Universities function in resident instruction, research, and extension. The extent and nature of university instruction is discussed, and the characteristics of university research are described. Extension activities include off-campus instruction, short courses, and adult education. The paper includes the conclusions of the ASEE-ANS Committee on Objective Criteria in Nuclear Engineering Education. (auth)

28664 THE ROLE OF THE GOVERNMENT IN NUCLEAR EDUCATION. John C. Cera (U. S. Atomic Energy Commission, Washington, D. C.). Preprint Paper No. 62. New York, Engineers Joint Council, 1962. 16p.

Why the Atomic Energy Commission as an agency of the Federal government has a role in nuclear education is discussed. Since 1955 the AEC has assisted over 500 educational institutions to initiate and expand courses in nuclear science and engineering. Three major objectives of the AEC educational assistance programs are discussed. Highlights of the Commission's programs of grants, loans of nuclear materials, faculty training, and special fellowships are presented along with a few statistics on the dollar magnitude of the programs. Mention is made of the AEC program for technical training of State and local regulatory personnel. The Commission's contribution to the Atoms for Peace program is discussed and a few statistics are presented showing the magnitude of this effort and numbers of foreign scientists and engineers trained. A few words are said about the massive contribution that is being made to nuclear science and engineering education by the multimillion dollar AEC research and development programs. The paper concludes with a discussion of several announcements of recent organizational changes in Federal agencies that will in time have an impact on the Government's role in education and research. (auth)

28665 NUCLEAR ENGINEERING EDUCATION FOR NAVY CIVIL ENGINEER CORPS OFFICERS. Wayne J. Christensen (Bureau of Yards and Docks). Preprint Paper No. 63. New York, Engineers Joint Council, 1962. 12p.

The Chief of Civil Engineers of the Navy, who is also the Chief, Bureau of Yards and Docks, has technical cognizance over design, construction, and maintenance of the Naval Shore Establishment including provision of all utilities.

The fulfillment of his attendant responsibilities to the Navy and the Nation include development and utilization of new methods and techniques where economies or other benefits will accrue. In this regard, utilization of nuclear energy has great potential. (auth)

28666 PLOWSHARE — APPLICATIONS OF NUCLEAR EXPLOSIVES. John S. Kelly (U. S. Atomic Energy Commission, Washington, D. C.). Preprint Paper No. 71. New York, Engineers Joint Council, 1962. 14p.

The feasibility of several applications of nuclear explosions is described. These applications include excavation, water resource development, mining, oil recovery, power production, isotope production, and scientific uses. The Gnome experiment is then discussed. (L.T.W.)

28667 ANNUAIRE DE l'ACTIVITÉ NUCLÉAIRE FRANÇAISE. (Yearbook of Nuclear Activities in France). Paris, Association Technique de l'Energie Nucléaire and Groupe Intersyndical de l' Industrie Nucleaire, 1961. 517p. (In French, English, and Spanish)

The application of atomic energy in France, participation in international organizations, training of specialists, information services, and patents rights are discussed. Separate lists are given of materials, suppliers, persons, and companies. The experience of the nuclear industry in France covers all the different elements of atomic infrastructure: mines, ores treatment, fuels elaboration and basic materials, equipment for research centers, practice reactors, reactors for research work, power reactors, irradiated fuels treatment, and enriched uranium. (P.C.H.)

28668 UNITED KINGDOM ATOMIC ENERGY AUTHORITY, EIGHTH ANNUAL REPORT FOR THE PERIOD APRIL 1, 1961-March 31, 1962. (United Kingdom Atomic Energy Authority, London). July 2, 1962. 98p.

Activities associated with processing plants, magnox reactors, reactor programs, general research and development, plasma and fusion research, isotope production, supporting work, nuclear weapons development, raw materials, commercial operations, health and safety, information services, international relations, and the authority staff are reported. (J.R.D.)

BIOLOGY AND MEDICINE

General and Miscellaneous

28669 (TID-15967) PROGRESS REPORT NO. 23 [ON BIOLOGICAL RESEARCH], NOVEMBER 1, 1961 THROUGH APRIL 30, 1962. (New England Deaconess Hospital. Cancer Research Inst., Boston). Contract AT (30-1)-901. 65p.

Research progress is reported on biological chemistry, biophysics and radiation protection, biostatistics, clinical contacts, experimental pathology, hematology, radiobiology, and x-ray diffraction. (M.C.G.)

28670 (UCLA-507) SEMIANNUAL PROGRESS REPORT [ON BIOLOGY AND MEDICINE] FOR THE PERIOD ENDING JUNE 30, 1962. (California. Univ. Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Contract AT-04-1-GEN-12. 91p.

Progress is reported in studies on the C^{14} activity of stearic acid and its degradation products from brains and carcasses of rats injected with carboxy-labeled acetate, the radiation chemistry of dilute aqueous solutions of potassium oleate, the catalytic hydrogenation of epoxystearates, the chromatographic analysis of natural waxes, metabolic and functional changes in single heart cells in tissue cultures, the radiation chemistry of dilute aqueous solutions of thymine, the development of a 2-phase solution-detergent-anthracene system for counting α and β radiation in aqueous solutions, the effects of Co^{60} gamma irradiation on solutions of crystalline papain, development of a rapid method for determining tritium water in urine following acute exposure, the distribution of Zn^{65} in rat plasma when injected intravenously as the inorganic ion, determination of sub-microgram amounts of labeled sulfates and selenates, as well as other metabolites, in plant and animal tissues by neutron activation of paper chromatographically separated compounds, the occurrence and character of intramitochondrial inclusions, the effects of x irradiation on fatty acid distribution in chicken embryos, the effect of estrogen on serum lipid and serum protein synthesis in various species of animals, tracer studies of metabolic activity in erythrocytes of chicken embryos in various stages of development, the biochemical effects of radiation of developing brains in rats, the transfer of light lipoproteins across cell membranes, the effects of radiation on protein synthesis in developing chicken embryos, the effects of radiation on life span in rats, effects of whole-body irradiation on metabolism of NaCl in rats, the effects of light intensity on metabolic activity in Euglena, the pharmacology and toxicology of scandium chloride and thulium chloride in rats, effects of low doses of x radiation on electrical activity in the brains of cats, the effects of irradiation on the intestinal absorption of pyridoxine and mucopolysaccharides in rats, reaction mechanisms in the induction of lethal radiation injuries and the protection afforded by chemicals, the role of radioactive tracers in the diagnosis of liver and kidney disorders, metabolism of Sr^{85} and Ca^{47} in human subjects, the protective effects of 5-hydroxytryptamine and 2-aminoethylisothiourea against radiation injuries in mice, the effects of Be on growth of bush beans, and the effects of fall-out on the ecology of the Nevada Test Site Area. A list is included of publications during the period covered by this report. (C.H.)

28671 (JPRS-13562) TRANSLATIONS FROM IZVESTIYA AKADEMII NAUK SSR, SERIYA BIOLOGICHESKAYA. Translation of Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 1, 3-12; 84-95; 102-105; 122-30; 141-50(1962). 55p.

Selected articles translated from Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya (News of the Academy of Sciences USSR, Biology Series), No. 1, 1962 are presented. Four papers and a summary of proceedings of the Fifth International Biochemical Congress are included. Separate abstracts were prepared for 3 of the 4 papers. (M.C.G.)

28672 (JPRS-13562(p.1-9)) THE EFFECT OF EXPLOSIVE DECOMPRESSION ON THE ORGANISM. V. I. Yazdovskii (Yazdovskiy), A. R. Mansurov, N. A. Agadzhanyan, and A. S. Tsivilashvili. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 1, 84-9(1962).

The results of dynamic roentgenological observations of the chest organs of animals subjected to large-scale and rapid pressure drops without the use of compensatory adaptations showed that in a part of the cases traumatic changes occur in the lungs which subsequently increase rapidly and the animals die. Both functional and morphologic changes which occurred in the chest organs were directly related to experimental conditions. (M.C.G.)

28673 (JPRS-13562(p.18-23)) ELECTRORETINOGRAM OF IRRADIATED EYE AND INDUCTION OF THE CORNEA. V. V. Popov and A. I. Farberov. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., No. 1, 102-5(1962).

In irradiated eyes of tadpoles (50 to 1500 r) which had lost the ability to cause corneal induction in skin transplants and regenerates, a quite regular change in the electroretinogram (ERG) was observed. The change in ERG was expressed chiefly in the delay in the inclusion effect, in the reduction in the "b" wave, and in an increase in the "d" wave. By the 16th to 18th day after irradiation the waves were of the same height and shape. It was concluded that the depressive effect of ionizing radiation on the formative power of the eye can be explained by a disturbance in the general equilibrium of the EGR in which possibility of carrying out the physiological and formative processes associated with the "a" wave is lost. (auth)

28674 (JPRS-13562(p.24-31)) THE DISTRIBUTION OF Co^{60} AND SOME RADIOISOTOPE FISSION PRODUCTS AMONG THE COMPONENTS OF EXPERIMENTAL BODIES OF WATER. I. O. Bogatyrev. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Biol., 122-6(1962).

Quantitative characteristics of the distribution of Co^{60}, Sr^{90}, Cs^{137}, Ru^{106}, and a mixture of fission products among the components in bodies of water were obtained. The bodies of water studied were suitable for the burial of liquid wastes containing the radioisotopes listed, with the exception of Sr^{90} which is retained for a long time in water. (auth)

28675 (JPRS-14829) COLLECTION OF THESES ON ACHIEVEMENTS IN MEDICAL SCIENCES IN COMMEMORATION OF THE 10TH NATIONAL FOUNDATION DAY OF CHINA. VOLUME II. Translated from "Ch'ingchu Chien'kuo Shih chounien I-hsueh K'o-hsueh Ch'engchiu Lu-wen Chi-hsia Chuan" Volume II, Peiping, December 1959. 702p.

Forty articles on pediatrics, dermatology, tuberculosis, radiology, and mental health are included; however, only

3 articles, which pertain to nuclear science, are abstracted in NSA. (P.C.H.)

28676 (JPRS-14829(p.493-519)) RADIOLOGY — THE PROGRESS OF CLINICAL RADIOLOGY IN NEW CHINA. Shao-hsun Wang (Wang Shao-hsun). Translated from p.725-37 of "Ch'ing-chu Chien'kuo Shih chounien I-hsueh K'o-hsueh Ch'eng-chiu Lun-wen Chi-hsia Chuan" Volume II.

A review on clinical radiology progress in China is divided into x-ray diagnostics of various diseases; such as occupational, parasitic infestations, endemic, cardiovascular, tuberculosis, and cancer; and roentgenotherapy of cancer and improvements in its technique. (P.C.H.)

28677 (JPRS-14829(p.574-83)) A PRELIMINARY EXPERIENCE WITH ACUPUNCTURE AND CHINESE TRADITIONAL DRUGS IN THE TREATMENT OF RADIATION REACTION. Hsien-chih Ku (Ku Hsien-chih). Translated from p.761-5 of "Ch'ing-chu Chien'kuo Shih chounien I-hsueh K'o-hsueh Ch'eng-chiu Lun-wen Chi-hsia Chuan" Volume II.

The therapeutic rate of acupuncture in the treatment of 283 cases of reaction to radiotherapy was over 90%. From initial results, it appears that acupuncture has a certain prophylactic value, though the appropriate sites for acupuncture have to be studied and selected. In the treatment of radiation dermatitis with Chinese traditional drugs, it was concluded that borneo camphor and egg white and Sze-huang Plaster are effective in treating radiation dermatitis. The lesions usually heal in 7 days after treatment. Borneo camphor and egg white may cause pain due to a drying-up of the skin; egg yolk ointment is contraindicated in infected lesions; the only disadvantage of Sze-huang Plaster is soiling of clothing. (P.C.H.)

28678 (JPRS-14829(p.584-93)) THE APPLICATION OF RADIOACTIVE ISOTOPES IN THE BASIC AND CLINIC MEDICINE. Shih-chen Wang (Wang Shih-chen) and Ken-yao Yeh (Yeh Ken-yao). Translated from p.765-73 of "Ch'ing-chu Chien'kuo Shih chounien I-hsueh K'o-hsueh Ch'eng-chiu Lun-wen Chi-hsia Chuan" Volume II.

A review of the achievements in the application of radioisotopes in clinical medicine and research in China during the last four years is presented. (P.C.H.)

28679 X AND GAMMA RAY EQUIPMENT FOR BIOLOGICAL RESEARCH. R. D. Brock (C.S.I.R.O., Canberra). Atomic Energy 5, No. 3: 29-32(July 1962).

A facility is described that contains a 5- and a 100-C Co^{60} source, a 250-kv 15-ma x-ray generator, and a laboratory. The irradiation capabilities of the facility are outlined. Dosimetry and radiation protection aspects of the operation are discussed. (T.F.H.)

28680 COMPARATIVE MUTAGENESIS OF THE DUMPY LOCUS IN DROSOPHILA MELANOGASTER. II. MUTATIONAL MOSAICISM INDUCED WITHOUT APPARENT BREAKAGE BY A MONOFUNCTIONAL ALKYLATING AGENT. E. A. Carlson and I. I. Oster (Univ. of California, Los Angeles and Inst. for Cancer Research, Philadelphia). Genetics, 47: 561-76(May 1962).

Monofunctional quinacrine mustard (ICR 100) induces mutations at the dumpy locus with an average frequency of 0.88%. More than 90% of the recovered dumpy mutations are distributed mosaically in somatic and gonadal tissues. Mutation frequencies at 16 other loci expressing visible effects were low or negligible. These experiments suggest that x-ray-induced mosaic mutations become established primarily at the first synchronous nuclear division of the zygote and that the ICR 100-induced mosaic mutations become established primarily at a later replication. Sex-linked lethals scored in the F_2 occur with a frequency of 3.7%; mosaic sex-linked lethals detected by scoring in the F_3 occur with a frequency of 13.7%. The mutational spectrum of the dumpy alleles induced by x rays does not differ appreciably from that induced by the ICR 100. ICR 100 is capable of inducing mutations in spermatozoa, spermatids, and the earlier stages of meiosis, including spermatogonia. No evidence for breakage events at the dumpy locus was detected in the progeny derived from ICR 100-treated sperm. The use of the sex-linked lethal test as ordinarily applied, i.e. by examination only of the F_2 generation, for determining the effectiveness of a chemical mutagen or for equating an equivalent roentgen dose to various concentrations of chemical mutagen can be misleading. However, the test can be made more meaningful by continuing the analysis for another generation and/or combining it with a test for visible mutations at specific loci. (auth)

28681 THERMAL SPIKES IN PROTEIN. A. Norman (Univ. of California, Los Angeles) and P. Spiegler. J. Appl. Phys., 33: 2658(Aug. 1962).

A formula is shown relating the temperature of an infinite medium through which a fission fragment passes with the distance from the axis defined by the fission-fragment track. This formula has cylindrical symmetry, and represents a temperature distribution that has a maximum at the track and falls off exponentially with the radius. An expression is derived relating the linear energy transfer (LET) of the fission fragment to the cross section (σ) of the cylinder within which the temperature is greater than the decomposition temperature of the protein in question. For enzymes, the inactivation cross section is equal to the decomposition cross section (i.e., to σ). An expression is found relating σ and LET, assuming that the temperature is uniform across the decomposed region; this expression is found to be valid for LET = 10^3 to 10^4 Mev cm^2 g^{-1}. (T.F.H.)

28682 MEAT IRRADIATION — THE ROLE OF GLUTATHIONE AND METHIONINE IN THE PRODUCTION OF HYDROGEN SULFIDE AND METHYL MERCAPTAN DURING IRRADIATION OF MEAT. Salvador Martin, O. F. Batzer, W. A. Landmann, and B. S. Schweigert (American Meat Inst. Foundation, Chicago). J. Agr. Food Chem., 10: 91-3(Mar.-Apr. 1962).

Experiments designed to determine the origin of the major volatile sulfur compounds formed during the irradiation of meat were carried out by adding to ground meat S^{35}-DL-methionine and S^{35}-glutathione, and irradiating with gamma rays at dosages from 2 to 10 megarads. Most of the methyl mercaptan appeared to be formed directly from free methionine. Some mercaptan was produced during the irradiation of glutathione, possibly indirectly or as a secondary product. Although H_2S was found in both cases as a product of the irradiation of methionine and glutathione, the observed isotope dilutions indicated that most of the H_2S apparently originated from other sulfur-containing precursors in meat. (auth)

28683 OCCUPATIONAL DERMATITIS FROM SENSIBILIZATION BY SODA AND LIME URANATES. H. Thiers and G. Chanial. J. Med. Lyon, 1661-2(Dec. 10, 1960). (In French)

Two workers of a plant in which uranium minerals are processed, are affected with a very particular dermatosis on the finger tips: dry, rugous, erosive, and dotted with small hyperkeratosic noduli. This dermatosis is not caused by any radio-noxiousness, but by an allergy to the uranous salts as shown by the tests as well as by the development of the dermatosis according to the kind of work carried out. (auth)

28684 PRELIMINARY EVALUATION OF THE IODINE-132 SOLUTION FROM THE BROOKHAVEN Te-132–I-132 GENERATOR. C. M. Neil (Brookhaven National Lab., Upton, N. Y.). J. Nuclear Med., 3: 352-9(Sept. 1962).

Evaluation of the new Brookhaven National Laboratory Generator for the production of iodine^{132} indicates it to be a simple and safe unit for general use. The I^{132} solution obtained from the generator is free of significant radioactive and chemical contamination by direct tests. Radiation calculations for internal administration in humans suggest that I^{132} reduces the radiation exposure by a significant amount as compared to I^{131}. (auth)

28685 RECOVERY OF ULTRA-VIOLET-IRRADIATED L STRAIN CELLS BY MEANS OF HIGHLY POLYMERIZED DEOXYRIBONUCLEIC ACID. Olga Djordjević, Ljiljana Kostić, and Dušan Kanazir (Inst. of Nuclear Sciences 'Boris Kidric'. Beograd, Yugoslavia). Nature, 195: 614-15 (Aug. 11, 1962).

Irradiated L strain cells were treated with highly polymerized isologous deoxyribonuclein acid (DNA), and results show that the irradiated cells survive better if they are treated after irradiation. In irradiated cultures treated with 80 μg DNA/ml only 10% of the irradiated cells died in a 4-day interval following irradiation, whereas in non-treated cultures for the same time-interval about 50% of the irradiated cells lost the capacity to divide. The recovery effect seems to depend upon the amount of DNA added to the irradiated cultures. Results of the effect with 21, 50, 60, and 80 μg of DNA/ml of culture show that significant survival is obtained with 60 and 80 μg. (P.C.H.)

28686 HIGH-RESOLUTION AUTORADIOGRAPHY WITHOUT LOSS OF WATER-SOLUBLE IONS. F. J. Hassbroek, J. C. Noggle, and A. L. Fleming (U. S. Soils Lab., Beltsville, Md.). Nature, 195: 615-16(Aug. 11, 1962).

A technique devised to provide a faster and less complex method for mounting paraffin sections directly on autoradiographic plates is described. By combining the procedures of flattening, mounting, and de-paraffinizing the sections, a new technique was devised to study the distribution of highly water-soluble S^{35} in barley roots. The resolution obtained and the reproducibility of autoradiographs of subsequent sections indicate that intimate contact between sections and emulsions are obtained with the technique. Another advantage is that sections stay in contact with the emulsion, which enables precise localization of the activity in the roots. The technique is simple and probably can be used for similar types of tissue that contain radioactive material that is insoluble in toluene. (P.C.H.)

28687 EVOLUTION OF PHOTOSYNTHETIC MECHANISMS. Melvin Calvin (Univ. of California, Berkeley). Perspectives in Biol. and Med., 5: 147-72(1962). (UCRL-9784)

Photosynthetic processes are reviewed, the types of organisms that perform photosynthesis are examined, the biological apparatus within these organisms are discussed, and reaction mechanisms at the molecular level are considered. The role of photosynthesis in the development of present-day organisms is discussed. (64 references.) (C.H.)

28688 THE USE OF P^{32} IN THE STUDY OF THE EFFECT OF X-RAYS ON THE FUNCTIONAL ACTIVITY OF THE SUPRARENAL GLANDS. S. Sladić-Simić, D. M. Pavić, and D. V. Radivojević. Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 22-5(Dec. 1961). (In Yugoslavian)

A method is described briefly for the use of P^{32} in studies on the effects of x radiation on functional activity of the adrenal glands in rats. (C.H.)

28689 USE OF RADIOACTIVE ISOTOPES IN EXPERIMENTAL IMMUNOLOGY. Miroslav Simić. Primena Ratioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 25-32(Dec. 1961). (In Yugoslavian)

The use of radioactive isotopes has provided a great stimulus for research in the field of experimental immunology. Radioactive tracer techniques have been employed in virtually all branches of immunological investigation. New possibilities of investigation offered by the use of radioactive isotopes on the fate of antigens in vivo: the properties, synthesis, and degradation of antibody molecule; and the use of labeled antibody in cancer research are reviewed. In all three of these areas much new knowledge has been gained through the use of tracer techniques. (auth)

28690 BLOOD VOLUME DETERMINATION AND SURVIVAL TIME OF RED BLOOD CELLS BY MEANS OF RED BLOOD CELLS LABELLED WITH Cr-51. Boris Kastelic and Bojan Varl ([Univ. of Ljubljana, Yugoslavia]). Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 32-6(Dec. 1961). (In Yugoslavian)

The technique of red blood cell labelling with Cr-51 is described and the method for the determination of the volume of red blood cells is described using for illustration some cases of normal RBC values, polycythemia, anemia, and pseudopolycythemia. The technique of determining the survival of red blood cells labelled with Cr-51 and experiences with 5 healthy (normal) and 10 pathologic cases are described. Cross-matching tests with Cr-51 labelled RBC in patients suffering from the extracorpuscular hemolytic anemia are also reported. (auth)

28691 THE SYNTHESIS AND LABELLING OF GLYCERIN-TRIOLEATE BY THE RADIOACTIVE IODINE. O. Miočka, M. Tunkl, S. Popović, and I. Šimonović. Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 44-8(Dec. 1961). (In Yugoslavian)

A method for the synthesis of glycerin-trioleate from glycerin and oleic acid is reported. The acid value of the preparation obtained was 1.1 to 1.3. The labeling of glycerin-trioleate by the radioactive iodine is given in detail. The preparation has been applied in a series of patients. The results obtained are in accord with literature data. (auth)

28692 LABELLING OF NUCLEIC ACID WITH RADIOACTIVE ISOTOPES AND THEIR APPLICATION. A. Bečarević, T. Hudnik-Plevnik, V. Glišin, J. Jankovać, D. Kanazir, M. Simić, and G. Ristić. Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 80-3(Dec. 1961). (In Yugoslavian)

The DNA of the liver and spleen of rats was labeled with P^{32}. The specific activity obtained was high enough to be able to follow the fate of these acids after injection in irradiated and non-irradiated rats. The results show that, after injection in the rats, the labeled acids were degraded into small fragments, which were utilized as building blocks for the synthesis of the big molecules of the cells. (auth)

28693 CENTERING CONTROL IN HIGH ENERGY RADIOTHERAPY BY MEANS OF RADIOGRAPHIC SUPERIMPRESSION OF THE IRRADIATION FIELD. F. Bono and G. F. Garusi (Universitâ, Bologna). Radiobiol. radioterap. e fis. med., (3) 16: 440-54(1961). (In Italian)

Experiences on check-up of radiographic centering in

high energy therapy (Van de Graaff generator, Co^{60} and Cs^{137} units) by means of a technical contrivance, that is, the "field superimpression", are described. After listing the technical details referring to the carrying out of radiograms with high energies, the more important practical applications of such a method are discussed. (auth)

28694 THE PHYSIOLOGY AND PATHOLOGY OF LEUKOCYTES. Herbert Braunsteiner, ed. American Edition Prepared and Revised by Dorothea Zucker-Franklin. New York and London, Grune and Stratton, 1962. 293p.

Results of recent studies on the physiologic, pathologic, and biochemical properties of leukocytes are reviewed. Separate abstracts were prepared on two chapters relating to the radiosensitivity of the hematopoietic system. (C.H.)

28695 OSNOVY MEDITSINSKOI RADIOLOGII. (Medical Radiology Handbook). V. I. Feoktistov. Leningrad, Medgiz, 1960. 163p.

Data are given on nuclear structure, nuclear reactions, and isotopes for biological, medical, and technological applications. Radiation measurements, permissible doses and concentrations of various isotopes in humans and in the atmosphere are discussed. Data are presented in a concise form with a minimum of formulas. The book is designed as a handbook for physicians, biologists, and laboratory personnel. (R.V.J.)

28696 ENGINEERING PROBLEMS IN NUCLEAR MEDICINE. E. E. Stickley (Columbia Univ., New York). Preprint Paper No. 72. New York, Engineers Joint Council, 1962. 31p.

The medical uses of nuclear energy are listed, and those aspects of these applications which invoke the professional skill of the engineer are described. (L.T.W.)

Biochemistry, Nutrition, and Toxicology

Refer also to abstracts 28659 and 28660.

28697 (BNL-5216) THE EFFECT OF THERAPY ON CELLS IN THE BLOOD OF LEUKEMIC PATIENTS CAPABLE OF INCORPORATING H^3 THYMIDINE. V. P. Bond, J. R. Rubini, T. N. Fliedner, and E. P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [Jan. 12, 1961]. Contract [AT(30-2)-Gen-16]. 14p.

The ability of circulating leukocytes to synthesize DNA was followed serially after therapy in patients with blood dyscrasias, using tritiated thymidine and autoradiography. Following Myleran therapy in myelocyte leukemia, the fall in labeled cells paralleled that of the total leukocyte count. In chronic lymphocytic leukemia, x-ray therapy to the spleen resulted in a marked drop in the total leukocyte count and a relative increase in the number of labeled cells. Steorid therapy did not decrease the leukocyte count or the number of labeled cells. The results indicate that these agents do not have a selective effect on circulating cells capable of DNA synthesis. The serial labeling indexes appear to be of little additional value for prognosis. (auth)

28698 (HW-SA-1997) THE UPTAKE OF STRONTIUM FROM DIET AND WATER BY RAINBOW TROUT. Robert H. Schiffman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 1960]. Contract AT(45-1)-1350. 8p.

The concentration ($\mu C/g$) of $Sr^{90}-Y^{90}$ in trout approached about 1.5 times the concentration ($\mu C/ml$) in the surrounding water in three weeks. Approximately 21% of the isotope administered in gelatin capsules was retained after one day but when the isotope was incorporated into natural food, the retention was only about 7%. It is inferred that, under the conditions of the experiment, uptake from the environmental water is greater than uptake through the food chain. (auth)

28699 (TID-7639) SECOND ANNUAL CONFERENCE ON PLUTONIUM, RADIUM AND MESOTHORIUM, SALT LAKE CITY, UTAH, JUNE 17, 18, 19, 1954. C. N. Stover, Jr., comp. and ed. (Utah. Univ., Salt Lake City. Radiobiology Lab.). 278p.

Results are reviewed from studies on the long-term toxic effects of Pu, Ra, and MsTh in dogs. Permissible body burdens for man of Pu, Ra, MsTh, and Sr were discussed on the basis of experimental evidence. The use of chelating compounds for removing such isotopes from bone and the equilibrium constants resulting therefrom were also discussed. (C.H.)

28700 (TID-12753) SKELETAL RETENTION OF THE ALKALINE EARTH RADIOISOTOPES AND BONE DOSIMETRY. R. E. Rowland (Argonne National Lab., Ill.). Mar. 1961. Contract [W-31-109-Eng-38]. 19p. (UAC-5096)

It is suggested that, following the deposition of any of the alkaline earth radioisotopes in bone, the dose to a bone tissue volume cannot be determined from a terminal observation of the distribution of the isotope unless the mechanisms which remove these isotopes from bone are known. On the basis of a study which demonstrated the magnitude of removal by exchange processes, it is suggested that all of the microscopic concentrations of the isotope in bone continually lose activity, and that this loss may be described by a power function of the form $q_t = q_0 t^b$. The concept of accumulated dose is discussed, and equations for the calculation of accumulated dose are derived on the basis of this hypothesis. (auth)

28701 (TID-16349) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center). May 1962. Contract AT(30-1)-952. 132p.

Studies were continued on the toxicity of Ra and MsTh in human beings having body burdens of about 0.02 μc Ra or the equivalent. Measurements were carried out to check the reproducibility of the whole-body counting methods and to investigate scanning techniques. The feasibility of thick-source α spectroscopy, using solid state detectors, for the analysis of bones containing Ra and MsTh was investigated. The relative uptake of Ac and Th by the intestine was measured. Data are presented on case histories and body burdens of Ra, MsTh, and Thorotrast in luminous dial painters and miscellaneous cases. The Cs^{137} levels in normal subjects and Cs^{132} levels in persons with tracer doses were determined by whole-body counting. The half-life of Cs^{132} was found to be 6.53 ± 0.03 days by the counting method used. An attempt failed to remove Thorotrast from a patient by the use of the chelating agent, diethylenetriaminepentaacetic acid. Investigations were continued on the behavior of Rn in the interstices of the soil. Preliminary results are presented from studies of underground Rn concentrations as related to meteorological variables and the effects of underground explosions on Ra and Tn concentrations in soil gas. Several complementary inspection techniques were developed that appear capable of serving as reliable locators of recent underground explosions. A list

is included of publications during the period covered by this report. (C.H.)

28702 (TID-16352) CHEMICAL AND BIOLOGICAL STUDIES ON NUCLEIC ACIDS AND DERIVATIVES. Progress Report, January 1, 1962–June 30, 1962. George B. Brown and Aaron Bendich (Sloan-Kettering Inst. for Cancer Research, New York). July 20, 1962. Contract AT(30-1)-910. 10p.

The study with cytidine-2-c-ribosyl-tritium was completed and submitted for publication to the J. Biol. Chem. A summary of results is given. In experiments with adenine oxide, it was found that decomposition of this compound can be followed with ultraviolet light, and by proper U.V.L. wavelength adjustment a secondary standard for dosimetry can be established. Analogs of adenylosuccinic acid were studied as substrates and inhibitors of adenylosuccinase. Results are summarized by A. Hampton in the J. Biol. Chem., 237: 529, 1962. (J.R.D.)

28703 (UR-614) PREPARATION AND HUMAN TRACER STUDIES WITH I^{131} LABELED ANTIBODY REACTING WITH FIBRIN. Irving L. Spar, William F. Bale, Ruth L. Goodland, Mary Jane Izzo (Rochester, N. Y. Univ. Atomic Energy Project). July 3, 1962. Contract W-7401-eng-49. 33p.

Techniques are described for preparing, from sera of rabbits immunized with human fibrinogen, I^{131}-labeled antibody reacting with fibrin and suitable for diagnostic use as an intravenously administered tracer in human patients. The final purified sterile preparations contain I^{131} label at a level of approximately 10 mC I^{131} per milligram of rabbit antibody protein. The labeled preparation almost quantitatively binds to freshly formed human fibrin in the presence of the plasma proteins, but does not bind to rabbit fibrin. Twenty-eight human patients were injected intravenously with the preparation with no untoward effects. Scintillation scanning of the head area of the patients with known or suspected brain tumors indicates that the preparations may be useful for diagnosis and delineation of brain lesions. Possibilities of increasing the effective preferential localization of this radioactive material in tumors for diagnostic or therapeutic purposes by the concurrent use of epsilon amino caproic acid, or other inhibitors of plasminogen activation or plasmin activity, are discussed. (auth)

28704 (HW-tr-32) CONTRIBUTION TO THE KNOWLEDGE OF THE METABOLISM AND THE RADIOTOXICOLOGICAL PROPERTIES OF CERIUM-144. A. Aeberhardt, P. Nizza, and Y. Arnaud. Translated for General Electric Co. Hanford Atomic Products Operation, Richland, Wash. from Bull. inform. sci. et tech. (Paris), No. 47, 2-22(Jan. 1961). 51p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 19123.

28705 (NP-tr-907) MOBILISATION OF RADIONUCLIDES BY MEANS OF ESTERIFIED POLYAMINOPOLYCARBOXYLIC ACIDS. A. Catsch. Translated by L. Rowe (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Intern. J. Appl. Radiation and Isotopes, 11: 131-8(1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 31964.

28706 BERYLLIUM CASE REGISTRY PROGRESS REPORT: 1962. Harriet Hardy (Massachusetts Inst. of Tech., Cambridge). Arch. Environmental Health, 5: No. 3, 265-8(Sept. 1962).

The Beryllium Case Registry was initiated in 1952 to develop knowledge of Be poisoning. A review of accumulated data suggests that Be in all forms must be considered potentially harmful. (C.H.)

28707 HEAVY WATER AS A PARTHENOGENIC AGENT. William Spindel and Paul R. Gross. Biol. Bull., 121: 409(Oct. 1961).

It was found that D_2O evokes parthenogenic division of eggs stored therein prior to fertilization. When unfertilized sea urchin eggs are stored in 99+% D_2O-sea water for 1-2 hours, then washed and returned to normal sea water, they cleave, in remarkably high percentages, at about 35 minutes after removal from D_2O (21°C). These are cleavages without benefit of sperm, and they continue for many hours, most cells becoming disorganized blastulae. The first cleavages are always multiple and irregular in such experiments, and the furrowing pattern is closely related to the distribution of the numerous cytasters which remain and grow after removal of the cells from D_2O. When the period of immersion is shorter, or the concentration of D_2O reduced, the time required for the appearance of the first parthenogenic cleavages increases rapidly; hence, for a ten-minute storage period, the first cleavage interval is 3-4 hours, and the final yield of divided cells is smaller. Parthenogenesis cannot be produced if the concentration of D_2O falls to 70% or less. The striking effects of prolonged storage in D_2O are not results of aging alone, since controls stored for the same intervals in normal sea water do not divide. The effect appears to depend upon the formation of stable cytasters, which begins in 99+% D_2O-sea water after 10 minutes of storage for unfertilized eggs. Thus, eggs stored in D_2O and then fertilized show normal cleavage in the absence of cytasters, but multiple cleavage when cytasters persist in the cytoplasm after removal of D_2O. (auth)

28708 THE UPTAKE OF RADIOACTIVE SULPHUR BY THE MOUSE KNEE JOINT AND BY THE SOFT TISSUES OF THE MOUSE HIND LIMB. C. W. Wilson (Westminster Hospital, London). Brit. J. Radiol., 35: 622-7(Sept. 1962).

The uptake of S^{35} by the knee joint and hind-limb soft tissues of the mouse following intraperitoneal injection of the isotope (as a sulfate) was examined for intervals of up to 96 hours after injection. In animals four to nine weeks old the almost instantaneous uptake of isotope by the knee joint is followed by a loss which has two exponential components of half-lives 2.3 hours and 47 hours, respectively. In three-week-old animals, however, the initial component is absent and the loss is entirely by way of the second 47-hour half-life component. In the case of hind-limb soft tissues the uptake curve with time after injection is the same for all animals three weeks or more of age. The curve shows the loss of isotope in this case to have three exponential components of half-lives 0.75 hour, 5 hours, and 60 hours, respectively. The latter is probably not significantly different from the 47-hour, slow component found for the knee joint. The importance of these results for future experiments which are planned to study the effect of x irradiation upon the uptake of S^{35} by these tissues is emphasized. (auth)

28709 ACCUMULATION AND REMOVAL OF RUTHENIUM-106, CERIUM-144 AND PROMETHIUM-147 BY THE FLY HALESUS INTERPUNCTATUS ZETT. A. B. Getsova and G. A. Volkova (Zoological Inst., Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1163-4(1962). (In Russian)

Continuing previously published studies (Doklady Akad. Nauk S.S.S.R., 133: (1960) No. 2; ibid., 139: (1961) No. 2.) on the desorption of radioactive materials from water insects, the removal of fission fragments from the fly Halesus

Interpunctatus Zett was investigated by means of the method described in the above-cited papers, taking into account the self-absorption of Pm^{147}. It was found that the residual activity of the insect depended on the length of their stay in the radioactive environment. From larvae, Pm was removed to the greater extent (residual activity 18%), followed by Ce (29%) and Ru (47%); from adult insects about half of the accumulated activity can be removed. Comparison with previous data on Sr and Cs indicated that there is a direct correlation between the period of accumulation and the removal of the radioisotope; Sr and Cs are removed to a greater extent from the adult specimens, Ru, Ce and Pm from the larvae. This is probably due to the ion-exchange type adsorption mechanism of Sr and Cs which can be washed off more easily from the surface of the adult insects. (TTT)

28710 PUQFUA, AN IBM 704 CODE FOR COMPUTING PLUTONIUM BODY BURDENS. James N. P. Lawrence (Los Alamos Scientific Lab., N. Mex.). Health Phys., 8: 61-6(1962).

PUQFUA is an IBM 704 Fortran program, written primarily for Pu^{239}, which calculates from urinalyses the plutonium body burden in microcuries and the percentage of the maximum permissible body burden. It is based on a set of power-function elimination equations developed for the excretion of plutonium over a five-year period. Results with PUQFUA compare favorably with those of other methods. In general, it is easy to apply for a large number of individual samples, and the validation method is objective and requires no past experience with plutonium body-burden calculations on the part of the evaluator. (auth)

28711 STUDIES IN THE METABOLISM OF CARRIER-FREE RADIORUTHENIUM. III. THE BEHAVIOUR OF NITROSYL-RUTHENIUM IN THE GASTROINTESTINAL TRACT. R. S. Bruce, T. E. F. Carr, and Mary E. Collins (Medical Research Council, Harwell, Berks, Eng.). Health Phys., 8: 397-406(Aug. 1962).

A study was made of factors which affect the absorption of the nitrosyl complex of Ru^{106} from the gastrointestinal tract of the rat. Absorption is normally complete within 2 hr. The rate of transit of the ruthenium through the gut and chemical combination with the contents may account for this limited period of absorption. However, about 20% of a dose is absorbed into the wall of the small intestine during the first hour while the total uptake into the rest of the body is only 2 to 4%. It appears, therefore, that passage from the gut wall into the blood is the limiting stage in the absorption of ruthenium nitrosyl. Fasting rats before the administration of ruthenium influences this stage and the 24-hr absorption into the body is increased threefold. The retention of ruthenium in the wall of the small intestine gives rise to considerable concentrations in the wall of the duodenum and upper jejunum. These tissues, which are particularly sensitive to radiation, consequently receive a higher total radiation dose than that resulting from the passage of the contents alone. (auth)

28712 EARLY UPTAKE AND DOSIMETRY OF Zn^{65} IN SHEEP. J. R. McKenney, R. O. McClellan, and L. K. Bustad (General Electric Co., Richland, Wash.). Health Phys., 8: 411-21(Aug. 1962). (HW-SA-2338)

The uptake and distribution of Zn^{65} were measured in three rams serially sacrificed at 5, 10, or 20 days following single administration; in two rams 20 days after single oral administration; and in three ewes in advanced pregnancy (with their fetuses) and in one ram fed Zn^{65} daily for 2 weeks. Direct measurements with Victoreen pocket dosimeters were taken in the major tissues following sacrifice of one of the ewes and the ram fed Zn^{65} daily. Data on the rams indicated that between 10 and 20% ingested radiozinc was absorbed from the gastrointestinal tract. Turnover rates of radiozinc were estimated at between 10 and 30% for most tissues and less than 2% per day for voluntary muscle and bone. In the ewes and ram fed Zn^{65} for 2 weeks, the highest concentrations were found in the liver, kidney cortex, mammary tissue, pancreas, and spleen, respectively. There was a 3-day lag before appreciable uptake was observed in the blood cells. The fetuses contained concentrations from one-tenth to one-half those in comparable tissues of the ewes. Total body was observed to be the critical organ for the ram and ewe used for the dose-rate measurements. (auth)

28713 COLLOIDAL RADIOACTIVE GOLD (Au^{198})—ITS CHARACTERISTICS. ITS INCORPORATION IN THE HUMAN BODY. R. Constant, J. Maisin, P. Vanderlinden, and A. Wambersie (Centre d'Etude de l'Energie Nucleaire, Brussels). J. belge radiol., 43: 393-412(1960). (In French) (BLG-73)

Colloidal solutions of radiogold are therapeutic agents used more and more for treatment of neoplasic pleuritis and ascitis. However, the value of these solutions depends largely on their preparation after fixed standards and can only be guaranteed by the use of well established methods of preparation. Clinical and laboratory investigations prove that the addition of sodium ascorbate allows nearly total elimination of residual soluble gold due to the slow reduction procedure. (auth)

28714 METABOLISM OF RADIOSTRONTIUM IN YOUNG PIGS AND IN LACTATING RATS FED STABLE STRONTIUM. John C. Bartley and Elwood F. Reber (Univ. of Illinois, Urbana and Illinois Agricultural Experiment Station, Urbana). J. Dairy Sci., 44: 1754-61(Sept. 1961).

Lactating rats fed stable strontium retained more radiostrontium, and carcasses of their young contained significantly more radiostrontium, than the lactating rats and their offspring which did not receive stable strontium. Results of these experiments were compared to the effect of stable strontium on the absorption of radiostrontium observed in other species. The effect of feeding stable strontium for ten days before the radiostrontium meal was not significantly different from feeding stable strontium simultaneously with radiostrontium. Feeding Hampshire pigs 21 days of age a ration containing 0.67% stable strontium, with 0.16 or 0.89% calcium, increased the amount of radiostrontium in the feces fourfold during the seven days after administration of radiostrontium. The amount of the absorbed radiostrontium appearing in the urine of the pigs fed strontium was about twice that of pigs not receiving strontium. The concentration of calcium in the diet had no marked effect on the quantity of radiostrontium in the urine and feces. Feeding stable strontium reduced the skeletal retention of radiostrontium three- to fourfold. (auth)

28715 COMPARATIVE STUDIES OF THE DISTRIBUTION OF RADIOACTIVE COLLOID GOLD Au^{198} AND RADIOACTIVE COLLOID GOLD COVERED WITH SILVER IN INTRA-ABDOMINAL ADMINISTRATION. M. A. Volkova and I. G. Ashikhmina. Med. Radiol., 7, No. 6, 32-6(June 1962). (In Russian)

Experimental investigations of the distribution of radioactive colloidal gold Au^{198} and radioactive colloidal gold plated with silver during intra-abdominal administration to rabbits disclosed that the accumulation of radioactive colloidal gold plated with silver in mediastinal and supraclavicular lymph nodes occurs more rapidly and in larger quantities than that of pure radioactive colloidal gold. The experimental data were confirmed by studies of the distri-

bution of the isotopes in 2 patients who had succumbed on the 7th day following operative intervention with introduction of isotopes into the abdominal cavity. (auth)

28716 PRESENCE OF SELENIUM-75 IN LIPOPROTEINS. K. P. McConnell and R. S. Levy (Veterans Administration Hospital, Louisville, Ky. and Univ. of Louisville, Ky.). Nature, 195: 774-6(Aug. 25, 1962).

Normal dogs were injected subcutaneously with $H_2Se^{75}O_3$ in dilute HCl which contained 1 mc Se^{75} (2 mg Se), and male rats were injected with a single dose of $H_2Se^{75}O_3$ in dilute HCl containing approximately 0.2 mc of Se^{75} and 40 μg Se. The lipoproteins were isolated by ultracentrifugation and electrophoretic analyses were performed. Results show that a small but significant percentage of the total serum protein-bound Se is bound to lipoprotein. Both the α and β lipoproteins of dog and rat serum bind Se^{75}, with the greatest percentage in the α fraction. In the dog, 3.58% of the total serum Se^{75} is bound to the lipoproteins of which 2.23% of the total serum Se^{75} is found in the α lipoprotein and 0.58% is found in the β or α-2-lipoprotein. In the rat, 8.83% of the total serum Se^{75} is bound to lipoproteins, of which 5.74% of the total is found in the α lipoprotein and 4.86% is found in the β lipoprotein. The significance of Se in serum lipoproteins is discussed. (P.C.H.)

28717 BINDING OF STRONTIUM IN BLOOD. T. E. F. Carr, G. E. Harrison, F. J. Loutit, and Alice Sutton (Medical Research Council, Radiobiological Research Unit, Harwell, Berks, Eng.). Nature, 195: 913(Sept. 1, 1962).

Blood plasma samples from several subjects after ingestion of Sr^{85} showed a lower specific activity than urine collected at the same time. The urine/plasma activity ratio ranged from 1.6 to 4.9, which implies either that the kidney is able to differentiate between different Sr isotopes or that Sr exists in two different chemical forms in blood. (D.L.C.)

28718 ANIMAL EXPERIMENTAL STUDIES ON IODINE METABOLISM IN INCREASED AND LOWERED THYROID FUNCTION. W. Keiderling, D. Emrich, S. Hahnemann, and G. Hoffmann (Universität, Freiburg i.B.). Nuclear-Med., 2: 385-96(1962). (In German)

Studies of iodine metabolism under various conditions were carried out in 30 rabbits using a method, described earlier, of comparing after quantitative separation, components of the plasma activity with I^{131}-tracer doses. Following stimulation of the thyroid gland with a thyrotropic hormone a shortening of the iodine phase and an earlier onset of the increased secretion of labelled thyroxine and triiodothyronine could be seen. These effects were not fully apparent from the uptake values and the total plasma activity. After acutely reducing the function of the thyroid gland with methylmercaptoimidazole a prolongation of the iodide phase with decreased uptake values and a retardation of the secretion phase with a decreased secretion rate of the total hormone to one third could be observed. These results are discussed in relation to radioiodine uptake tests in human subjects and to the mode of action of thyrotropic hormone and methylmercaptoimidazole. (auth)

28719 INVESTIGATION ON THE DISTRIBUTION OF Cu^{64}. H. Kutzim and O. Wilcke. Nuclear-Med., 2: 421-8 (1962). (In German)

The distribution of Cu^{64} in the form of EDTA and glycocoll complex compounds was investigated by direct measurement of tissue concentrations and by autoradiographies of slices of the whole animal body. In adult animals the liver and kidneys showed the highest Cu^{64} concentration. In young mice the highest Cu^{64} concentration was found by autoradiography at the epiphysial line of the bones and was 3 to 4 times higher than the Cu^{64} concentration in the liver. These results are discussed in relation to the copper deficiency disease known as "saltsick". (auth)

28720 THE EFFECT OF pH ON THE ABSORPTION OF Sr^{89}, P^{32}, AND Fe^{59} IONS BY LEAVES OF ZEA MAYS. T. W. Sudia and A. J. Linck (Univ. of Minnesota, St. Paul). Ohio J. Sci., 61: 107-12(Mar. 1961).

The absorption and translocation of phosphorus-32, iron-59, and strontium-89 by the leaves of 10-day-old corn plants were studied as functions of pH. The pH of the solution in which the mineral ion is supplied to the corn plants had a significant effect on absorption. For the three mineral ions studied, greater absorption occurred at the lower pH values of 2.5 and 4.5 and significantly lower amounts were absorbed at the higher pH values of 7.0 and 8.2. All three mineral ions are readily absorbed by the leaves of corn but they differ markedly in the amount of each ion transported from the leaves. For the isotope of phosphorus, between 10 and 18% of the total activity in the plant is found in the stem and leaves following transport from the applied leaf. These figures can be compared to from 45 to 67% of the iron translocated. Less than 2% of the radiostrontium was transported from the applied leaf. (auth)

28721 INFLUENCE OF DIETARY STABLE STRONTIUM AND CALCIUM ON THE TURNOVER OF BONE-FIXED Sr^{85} IN MAN. Stanton H. Cohn, Herta Spencer, Joseph Samachson, Arthur Feldstein, and Ernest A. Gusmano (Brookhaven National Lab., Upton, N. Y.). Proc. Soc. Exptl. Biol. Med., 110: 526-8(July 1962). (BNL-5859)

The turnover of Sr^{85} was determined for four patients by whole-body counting for a period of 130 days following administration of the isotope. The data obtained were expressed as power functions. Two patients then received Sr lactate, and the other two Ca gluconate as dietary supplements for a period of 110 days. Sr^{85} turnover was determined for this period and again expressed as a power function for each patient. While the data suggested that the addition of Ca gluconate to the diet somewhat decreased Sr^{85} excretion and the addition of Sr lactate slightly enhanced excretion, no statistically significant changes in the long-term turnover rate of Sr^{85} were observed. (auth)

28722 COMPARATIVE FIXATION OF Sr^{89} AND Ca^{45} BY CALCIFIED TISSUES AS RELATED TO FLUORIDE INDUCED CHANGES IN CRYSTALLINITY. J. Menczel, A. S. Posner, H. Schraer, G. Pakis, and R. C. Likins (National Inst. of Dental Research, Bethesda, Md.). Proc. Soc. Exptl. Biol. Med., 110: 609-13(July 1962).

X ray diffraction analyses, and Sr^{89} and Ca^{45} uptake studies in tibiae and incisors of control and fluoride treated one-year-old rats were carried out. In the tibia ends and shafts an improvement of bone apatite crystallinity in the direction of the a axis and not the c axis was produced by fluoride ingestion. No changes in incisor apatite crystallinity were observed. Uptake of Ca^{45} and Sr^{89} was decreased in the tibia ends of the 25 and 50 ppm F treated animals. Sr^{89}/Ca^{45} ratios in the tibia samples were the same as in the serum specimens. There was a discrimination against Sr in relation to Ca in the incisor bases. Radioactivity in the tibia of one-year-old animals was $1/40$ to $1/80$ of that found in a group of young animals treated similarly in an earlier experiment. In the young rat the tibia ends were found to incorporate more Sr^{89} and Ca^{45} than the incisor, while the opposite was found in the older rats. (auth)

28723 ACCUMULATION OF RADIOACTIVE STRONTIUM AND YTTRIUM IN EGGS OF MARINE FISH. G. G.

Polikarpov and V. N. Ivanov (Sebastopol Biological Station, Academy of Sciences, USSR). Radiobiologiya, 2: 207-10 (1962). (In Russian)

Accumulation coefficient of Y^{90} in whole roe and in the membrane indicate the real sources of increased ionizing radiation in sea fish during development in water contaminated by small amounts of Sr^{90} and Y^{90} (10^{-10}/l and over). (R.V.J.)

28724 A CONTRIBUTION TO THE PATHOGENETIC PROBLEM OF HERPES ZOSTER IN THE COURSE OF IRRADIATED NEOPLASMS (PRESENTATION OF 21 PERSONAL CASES). I. Ciampelli and R. Crocella (Università, Florence). Radiol. med., 48: 589-601(June 1962). (In Italian)

Cases of Herpes Zoster observed in patients with neoplasms who were undergoing radiation or chemotherapeutic treatment are reported. Although no statistical value is attributed to the caselist, the higher incidence of symptomatic Zoster in systemic forms and particularly in lymphogranuloma is confirmed. On the basis of the concept of conditioned infectious disease, it is believed that the taking of the Herpes virus is mainly favored by the fall in the body's defense powers. The local effect of the ionizing radiations or of the neoplasm itself might have a certain value in localizing the virus in a given nervous segment. (auth)

28725 CALCIUM-47 AND STRONTIUM-85 TRACER STUDIES AS A GUIDE TO ISOTOPE THERAPY OF BONE METASTASES. O. H. Pearson, S. Solaric, F. W. Lafferty, and J. P. Storaasli (Western Reserve Univ., Cleveland). Radiology, 79: 446-51(Sept. 1962).

Preliminary results of Ca^{47} and Sr^{85} kinetic and local uptake studies in patients with bone metastases as a possible guide to isotope therapy are presented. The findings suggest that patients who do not have a significant differential uptake of isotope in the areas of the lesions will not benefit from treatment with isotopes. Ca^{47} proved to be an effective therapeutic agent in a patient with widespread osseous mammary metastases unresponsive to endocrine therapy. (auth)

28726 THYROID UPTAKE STUDIES WITH I^{131} IN VERY SMALL DOSES. John R. Cameron and Douglas B. Bell (Univ. of Wisconsin, Madison). Radiology, 79: 452-6(Sept. 1962).

A tracer dose of 0.1 to 0.2 μc I^{131} for determination of 24-hour thyroid uptakes as used in this study seems to be sufficiently accurate for screening purposes. Other uses would be in baseline determinations for persons whose thyroids will be stimulated later by TSH or on whom thyroid suppression with triiodothyronine will be tried. In these cases the contribution by the small dose would be about 1% of the regular dose and thus could be ignored on the second measurement. Not the least advantage would be the reduction in radiation to the thyroid gland from about 10 rem in a typical uptake with standard quantities to 0.1 rem with the small doses. This latter amount is comparable to the background radiation received by the thyroid in one year. (auth)

28727 CONCENTRATION OF CESIUM-137 IN HUMAN RIB BONE. Robert W. Anderson and Philip F. Gustafson (Argonne National Lab., Ill.). Science, 137: 668(Aug. 31, 1962).

The concentration of fission product cesium-137 in human rib, sampled from various age groups, was determined by low-level gamma-ray spectrometry. We propose several possible interpretations of the data and point out the possibility that mechanisms of cesium retention may be age-dependent. (auth)

28728 STUDIES ON RADIATION DISTURBANCES DURING TREATMENT OF UTERINE CANCER, ESPECIALLY ON A RADIOPATHOGENIC SUBSTANCE AND A NEW TYPE OF THERAPY (ENGLISH TEXT). K. Kushima and H. Yoshizaki (Tohoku Univ. School of Medicine, Sendai). Tohoku J. Exptl. Med., 74: 286-98(1961).

A substance named radiotoxin was extracted with alcohol and ether from the blood of rabbits suffering from radiation disturbances. Radiation disturbances are probably caused by production of radiotoxin in the irradiated body, which first induces radiation sickness and leukopenia by acting on the autonomic nervous center, while stress due to the irradiation deranges the endocrine function via the hypophyseo-adrenocortical system. A course of radiotherapy causes, both by the radiation itself and by the radiotoxin it produces, hypofunction of the hematopoietic organs and dysfunction of the liver and kidneys. In a new type of therapy, a patient with leukopenia and thrombocytopenia was injected intravenously with 100 ml of human blood which had been irradiated with 300 r of x rays. A good remission was obtained. (Abstr. Japan Med., 2: No. 7, July 1962)

28729 MEMBRANE TRANSPORT AND METABOLISM. Proceedings of a Symposium held in Prague, August 22-27, 1960. A. Kleinzeller and A. Kotyk, eds. London, Academic Press, Inc., 1961. 608p.

A symposium on Membrane Transport and Metabolism was held in Prague, August, 1960. The formal papers by participants and discussions are presented. Topics discussed included the general aspects of transport phenomena across cellular and biological membranes; transport of ions, saccharides, amino acids, and amines across cellular and biological membranes; and transport phenomena and regulation of cell metabolism. (C.H.)

Fallout and Ecology

Refer also to abstract 29245.

28730 (TID-3910) TERRESTRIAL AND FRESHWATER RADIOECOLOGY: A SELECTED BIBLIOGRAPHY. Alfred W. Klement, Jr. and Vincent Schultz (Division of Biology and Medicine, AEC). Mar. 1962. 79p.

References (1980) are given to journals, reports, and theses published from approximately 1948 through 1961. A separate list of 50 bibliographies is also included. (P.C.H.)

28731 FISSION-PRODUCT RADIOACTIVITY IN PRECIPITATION ON GLACIER SURFACES, IN GRASSES AND ANIMALS FROM MEASUREMENTS AT DIFFERENT ALTITUDES IN THE NORTHERN ALPS IN THE YEARS 1957 TO 1960. Reinhold Reiter. Arch. Meteorol., Geophys. Bioklimatol., Ser. A, 12: 222-61(1961). (In German)

Measurements of artificial β and γ radioactivity in precipitation, on glacier surfaces, and in samples of grass and animal matter are described. The observations were carried out regularly since 1957/58. Samples from different altitudes were taken simultaneously at two alpine stations (altitude difference 1.1 km, horizontal distance 2.5 km). Glacier ice was sampled at an altitude of 2600 m. In addition to the determinations of radioactivity, analyses of radioisotopes were carried out. Comparison of the results from different altitudes shows that the specific radioactivity of precipitation during the last kilometer of its fall increases by about 20%, while the mean addition of radioactive matter to the ground is about equal at the upper and

lower station (due to the different amounts of precipitation). The specific radioactivity of grass ashes shows a marked increase with altitude which cannot be explained by a different supply of radioactive matter to the ground. The grass in different altitudes shows no differences in water and mineral content which might otherwise explain the dependence on altitude of radioactive contamination. The concentration of nuclear fission products found on glacier surfaces is very high (maximum several $1000 \cdot 10^{-7}$ $\mu c/cm^3$). The radioactivity of precipitation with respect to the general meteorological conditions (e.g. instability), the decrease with time (after date of nuclear explosion), and the relationship to radioactivity of the air (wash-out effect) are discussed in detail. Measurements of the radioactivity of precipitation are often biased by radioactive dust carried off the ground by turbulence. Therefore, the most reliable determinations of radioactive contamination from the cloud level are obtained by using the precipitation of high altitude stations. (auth)

28732 THE CONCENTRATION AND ACCUMULATION OF RADIOACTIVE PHOSPHORUS BY AN AQUATIC FOOD CHAIN. Dale Arthur Hoffman (Colorado State Univ., Fort Collins). Dissertation Abstr., 23: 364-5(July 1962).

The food chain consisted of green algae, Ankistrodesmus falcatus var acicularis (A. Br.) West; microcurstaceans, Daphnia magna Straus; and Green Sunfish, Lepomis cyanellus Rafinesque. Differences in concentration and accumulation of radioactive phosphorus due to variations in temperature, radioactive and non-radioactive phosphorus content, and combination of organisms were determined. The average accumulation by all Daphnia at 25°C was 2.0 times that at 10°C. The Concentration Factor was 1.8 times the 10°C value at 25°C. The accumulation value for algae at 25°C was 2.1 times that at 10°C while the Concentration Factor was 3.1 times greater. The data indicate that the presence of algae provided a small increase in the amount of available phosphorus for Daphnia in the first 24 hours. However, over longer periods of time the algae apparently directly and/or indirectly reduced the amount of available phosphorus. The accumulation values for algae ranged from 0.2 to 1937 $\mu c/gm$, and for Daphnia from 0.85 to 574 $\mu c/gm$. The Concentration Factors for algae ranged from 136 to 626,976 and from 286 to 1,002,926 for Daphnia. The data indicate that the amount of P^{32} accumulated and concentrated by Daphnia may be influenced by the surface area available for adsorption of phosphorus. An increase in the number of algae cells increased the surface on which bacteria could grow. It was noted that Green Sunfish acquired the most radioactive phosphorus from a diet of Daphnia and algae, less from Daphnia alone, still less from a diet of algae alone, and none from a non-algae, non-Daphnia diet. It appears that direct and indirect interspecific competition may have occurred for phosphorus within the food chain. (auth)

28733 CRITERIA FOR ESTIMATING THE DANGERS TO DRINKING WATER BY RADIOACTIVE FALL-OUT. K. Haberer (Technische Hochschule, Karlsruhe, Ger.). Kerntechnik, 4: 286-7(July 1962). (In German)

The permissible fall-out activity concentrations in water are calculated on the basis of the mixing law of the first SSVO, with latest compilation data derived from nuclear weapon fission mixtures [3]. The permissible concentrations, which depend on the age of the mixture, are compared to the values obtained according to different published criteria. (auth)

28734 RADIOACTIVITY OF KOREAN FOODS. 1. BETA RADIOACTIVITY OF FOODS. Tai-won Park, Tai-soon Kim, and Chun-young Lee. Kwayon Hwibo, 5: 167-72(1960). (In English)

The beta radioactivity of Korean daily foods was measured. The activity ranged over 10 to 78 dpm per 100 mg ash or 0.44 to 44 $\mu\mu c$ (0.99 to 97.87 dpm) per gram of fresh sample. (auth)

28735 RADIOACTIVITY OF KOREAN FOODS. 2. CESIUM-137 IN FOODS. Chun-young Lee, Tai-won Park, and Tai-soon Kim. Kwayon Hwibo, 5: 173-7(1960). (In English)

Cs^{137} was determined in a few conventional foods in Korea collected from the vicinity of Seoul during the period of 1957 to 1960. Data are given. (D.L.C.)

28736 SOME RECENT MEASUREMENTS OF CAESIUM-137 AND ZIRCONIUM-95 IN HUMAN BEINGS. J. Rundo and D. Newton (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 195: 851-4 (Sept. 1, 1962).

Measurements since Sept. 1960 of Cs^{137} fall-out in a small group of control subjects are tabulated, and all the measurements from 1956 to 1962 are plotted. The Cs^{137} content declined from a maximum of ~60 $\mu\mu c/g$ K in 1959 to 29 $\mu\mu c/g$ K in April 1962, although a provisional increase to 35 $\mu\mu c/g$ K was observed in July 1962. Zr^{95}-Nb^{95} was detected in the lungs by placing the detector under the sternum, and the average content was 300 $\mu\mu c$/person and 0.35 $\mu\mu c/g$ lung. It is noted that the dose rate from Cs^{137} and Zr^{95} is small compared with that from natural background. (D.L.C.)

28737 BOVINE THYROID IODINE-131 CONCENTRATIONS SUBSEQUENT TO SOVIET NUCLEAR WEAPON TESTS. Clifton Blincoe and V. R. Bohman (Univ. of Nevada, Reno). Science, 137: 690-1(Aug. 31, 1962).

The iodine-131 concentration in thyroids of cattle slaughtered in Reno, Nevada, was measured during and following recent atmospheric nuclear weapon tests by the U.S.S.R. The iodine-131 concentration rose rapidly to a maximum and then declined with an apparent half-life of 7 days after conclusion of the test series. The average dose to bovine thyroids from this test series was estimated to be 17 rads. (auth)

28738 NEVADA TEST FALLOUT AND RADIOIODINE IN MILK. Ralph E. Lapp. Science, 137: 756-8(Sept. 7, 1962).

The iodine-131 dosage to infant thyroids as a result of Nevada testing is evaluated. The case of heavy fallout in the Troy, N. Y., area on 26 April 1953 is cited. The possibility is discussed that a thyroid cancer survey would provide a critical test of linear response versus threshold theory for radiation injury to tissue. (auth)

28739 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, JULY 1962. Volume III, Number 7. (Public Health Service, Washington, D. C.). 51p. $0.50(GPO).

Data on environmental radiation levels are presented. Fallout monitoring was carried out on air and precipitation, food, milk, and water. Results are reviewed and summarized. (M.C.G.)

Radiation Effects on Living Tissues

28740 (BNL-5039) COMMENTS ON THE CONFERENCE WITH RESPECT TO ADVANCES IN THE FUNDAMENTAL ASPECTS OF PLANT AND SEED RADIOBIOLOGY. Arnold H. Sparrow (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 8p.

Fundamental aspects of plant radiobiology are summa-

rized. The fundamental role of chromosome breakage in radiation genetics and in plant radiation biology is stressed. The effects of ploidy, dose rate, dose fractionation, and recurrent and chronic exposure on the induction of mutations by radiation exposure of seeds and other plant materials are discussed. (C.H.)

28741 (BNL-5089) ATOMIC RADIATION AND CROP IMPROVEMENT. Seymour Shapiro (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 17p.

Applications of atomic radiation in crop improvement programs are discussed. Reaction mechanisms involved in the induction of mutations in plants are reviewed. It is pointed out that most radioinduced plant mutations will be sterile or have deleterious characteristics. However, if the plant breeder can employ accurate and efficient means of screening large populations, the presence of rare individuals carrying desired traits will make the sacrifice of large numbers of plants of no consequence. A number of new radiation-produced varieties of grains, flowers, and vegetables are described briefly. (C.H.)

28742 (BNL-5340) EFFECTS OF RADIATION ON INTESTINAL ABSORPTION. V. P. Bond (Brookhaven National Lab., Upton, N. Y.). [1960]. Contract [AT(30-2)-Gen-16]. 24p.

A review is given on the physiological and pathological changes that occur in the gastrointestinal tract following exposure to penetrating radiations. Relatively small doses of radiation produce transient but marked changes in gastric emptying time, and in gastrointestinal motility. At higher, but sublethal doses, transient effects on the gastrointestinal epithelium occur in the first few days, resulting from damage to dividing crypt cells. In the lethal range, pathological changes in the mucosa, secondary to infection and hemorrhage, occur in the second week or later. At supralethal doses, the intestinal villi are denuded completely of epithelium just prior to death, on the 3rd to 5th day. Gastrointestinal death following whole-body irradiation appears to be due, at least in part, to a terminal loss of electrolytes and water into and through the denuded intestine. (P.C.H.)

28743 (NYO-10152) BIOLOGICAL EFFECTS OF RADIATION, AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Summary Progress Report, July 1, 1950–October 31, 1961. (Sloan-Kettering Inst. for Cancer Research, New York). Jan. 31, 1962. Contract AT(30-1)-910. 125p.

Progress is reported in kinetic studies of the metabolism of I^{131} and I^{131}-labeled compounds in man, the metabolism of Ca^{47} and Sr^{85} in patients with bone disease tracer studies on the metabolism of nucleic acid precursors and steroid hormones in man, measurements of electron spin resonance of free radicals produced in irradiated compounds of biological importance, measurements of secondary electron spectra produced by γ-emitting radioisotopes in water, radioautographic studies of isotope localization in tumors, bone marrow, and blood of leukemic patients, studies on the relationship of structure to biological activities and chemical properties of adenine and its monohydroxy derivatives, the development of techniques for the fractionation of nucleic acids, investigations on the physicochemical properties of nucleic acids, studies of the characteristics of the cytoplasmic ribonucleoprotein particles from mammalian tissue, and the quantitative measurement of the effects of x rays of different qualities on the bones of living mice and the correlation of these measurements with the amount of energy absorbed in the sensitive volumes of the bones. Educational programs are summarized and a list is included of publications during the period covered by this report. (C.H.)

28744 (TID-12163) PATHOLOGIC SEQUELLAE IN BEAGLES FOLLOWING CONTINUOUS FEEDING OF Sr^{90} AT A TOXIC LEVEL. A. C. Anderson and M. Goldman (California. Univ., Davis. School of Veterinary Medicine). [Mar. 29, 1961]. Contract AT(11-1)-Gen-10. 12p.

Beagles were fed Sr^{90} at a constant level (1.83 μC Sr^{90}/g dietary Ca) from the onset of fetal ossification to 18 months old. During the treatment period, lymphoblastic sarcoma caused death of 2 dogs after about 1000 rad of skeletal irradiation. In one dog an osteogenic sarcoma occurred in the lumbar region with lung metastases after an accumulated dose of approximately 12000 rads. Aseptic osseous necrosis and circumscribed areas of osteolytic fibrosis were identified as slowly progressive lesions. Excessive ossification in the metaphases of long bone was a constant finding after maturity. One surviving dog has sustained a cumulative dose in excess of 15000 rad and is also exhibiting bone pathology radiographically. Leukocytic elements were moderately depressed (60 to 70% normal), but thrombocytic values were well within normal range. (auth)

28745 (TID-16401) PROGRESS REPORT ON [RADIOLOGICAL RESEARCH]. Carl C. Lindegren (Southern Illinois Univ , Carbondale). July 14, 1962. Contract AT(11-1)-424. 29p.

Research progress on both yeast genetics, particularly multiple allelism, and some basic aspects of radiation genetics of this organism is reported. Topics covered include: orderly degradation of the melezitose (MZ) locus of saccharomyces by ultraviolet radiation and its regeneration by contact with substrate; alterations in the MZ locus of saccharomyces by radiation, substrate, and allelic genes; genetic fine structure of MZ locus of saccharomyces; the centriole as a primary radiation target in saccharomyces; cleavage of MZ and panose by cell-free extracts of saccharomyces; ultraviolet induction of respiration-deficient mutants of saccharomyces and their stability during vegetative growth; photoreactivation studies on killing and extrachromosomal mutations in saccharomyces; evidence of genetic control of photoreactivation; preliminary studies on the photoreactivation of ultraviolet enhanced non reciprocal and reciprocal recombination in saccharomyces; method for procuring biochemical mutants of saccharomyces; and transfer of genetic traits to protoplasmic monolayers of yeast by cell-free subcellular fractions. (M.C.G.)

28746 (TID-16428) MUTATION RATES AT SPECIFIC LOCI IN DROSOPHILA MELANOGASTER. Period Covered: November 1960 through April 1961. Supplementary Report for March and April 1961. Aloha Hannah-Alava (Turku, Finland. Univ.). Contract IAEA 31/US. 7p.

Progress is reported in studies on the genetic effects of x radiation in Drosophila. Data are presented on radiation damage, as measured by mutation rates at specific visible autosomal loci, of male germ cells of two species of Drosophila. Emphasis was placed on the comparative mutation rates of gametes in different stages of maturation at the time of radiation exposure. (C.H.)

28747 (TID-16429) MUTATION RATES AT SPECIFIC LOCI IN DROSOPHILA MELANOGASTER. Final Report, November 1, 1960 through October 31, 1961. Aloha Hannah-Alava (Turku, Finland. Univ.). Dec. 12, 1960. Contract IAEA 31/US. 7p.

Radiation effects on mutations in male germ cells of Drosophila melanogaster were studied for the purpose of relating the brood pattern to the spatial pattern of spermatogenesis. The procedure of mating individual males successively to 7 to 10 females (per mating) on days 3, 5, 7, 10, 12, and 14 after radiation and the initial mating were found to be the most satisfactory. The critical period, excessive sterility, occurred in the third brood (6 to 8 days following radiation). The brood patterns and mutations did not differ significantly. (P.C.H.)

28748 (TID-16430) MUTATION RATES AT SPECIFIC LOCI IN DROSOPHILA MELANOGASTER. Period Covered: November 1, 1961 through April 1962. Aloha Hannah-Alava (Turku, Finland. Univ.). Contract IAEA 31/US. 7p.

Radiation effects, as measured by mutation rates at specific, visible, autosomal loci, upon the male germ cells of different species of Drosophila was studied with special emphasis upon accumulating detailed information about the kinds of mutations and mutation rates at individual loci in the germ cells of D. melanogaster in different physiological states at the time of irradiation. The brood procedure was used for obtaining mutations. The percentage of fertile males was found to decrease progressively from brood 1 to 7 with the exception of brood 3 (6 to 8 days), which was lower than the last broods. The lowest number of offspring per male was found in the third brood with a progressive increase from the fourth to the seventh broods. A progressive decrease in mutations from the fourth seventh broods was also found. (P.C.H.)

28749 (TID-16446) STUDY AND COMPARISON BETWEEN NECROLYTIC AND RADIOLYTIC LESIONS AT THE MITOCHONDRIAL LEVEL (LYSOSOMES) IN ASEPTICAL PERFUSED HEART MUSCLE. Period Covered: October 1, 1960–October 1, 1961. ([Trieste. Universita]). Contract IAEA 69/US. 21p.

Progress is reported in studies on the effects of x radiation on enzyme activity in beef heart mitochondria. Methods are described for the preparation of beef heart homogenates and assay of enzyme activity. (C.H.)

28750 (TID-16447) STUDY AND COMPARISON BETWEEN NECROLYTIC AND RADIOLYTIC LESIONS AT THE MITOCHONDRIA LEVEL (LYSOSOMES) IN ASEPTICAL PERFUSED BEEF HEART MUSCLE. ([Trieste. Universita]). [1967]. Contract IAEA 69/US. 20p.

Progress is reported in studies on the effects of x radiation on enzyme activity in beef heart mitochondria. Methods are described for the preparation of beef heart homogenates and assay of enzyme activity. (C.H.)

28751 (TID-16471) RADIATION EFFECTS ON THE CYTOPLASM OF HABROBRACON EGGS. Final Report, June 1, 1956–May 31, 1962. Walter Kenworthy (Brown Univ., Providence). May 31, 1962. Contract AT(30-1)-1920. 22p.

A cytological examination of eggs which had received x-ray doses sufficiently high to inhibit the functioning of the female pronucleus was made. Since nothing other than androgenetic males would survive at these high doses, the study consisted of a measure of the production of androgenetic males in relation to x-ray doses. Results are presented on cytological studies of irradiated eggs of known age, irradiated sperm and its effect on egg development, dose-action survival curves for high x-ray doses, effects of radiation on the rate of cell membrane formation, neutron bombardment effects on Habrobracon eggs, attempts to produce androgenetic individuals by heat shock and anoxia, and hybridization of Habrobracon juglandis and Habrobracon brevicornis. (N.W.R.)

28752 (UCLA-461) INFLUENCE OF X-IRRADIATION ON THE RESPONSE OF THE GUINEA PIG ENTERIC GANGLIA AND POST GANGLIONIC CHOLINERGIC NERVE ENDINGS TO DRUGS. Thomas J. Haley, P. Williams, N. Komesu, and A. M. Flesher (California. Univ., Los Angeles. School of Medicine). July 26, 1960. Contract AT(04-1)-Gen-12. 10p.

A study was made of the responses of the x-irradiated and non-irradiated guinea pig intestine to ganglionic and antispasmodic drugs. There were no significant differences in the responses obtained prior to and for three days post-irradiation. Furthermore, there were no significant differences in the amounts of acetylcholine secreted by irradiated and non-irradiated small intestine during this time interval. The results are discussed in terms of the reported increase in intestinal tone produced by irradiation and it is concluded that the site of action for inducing this effect was not peripheral but central. (auth)

28753 (JPRS-13820) EXCERPTS FROM MEDITSINSKAYA RADIOLOGIYA (MEDICAL RADIOLOGY). Translation of Meditsinskaya Radiologiya, 7: No. 2, 3-36; 42-8; 58-64; 68-71; 87-93(Feb. 1962). 74p.

Translations are presented of articles covering the prophylaxis and treatment of injuries to healthy tissues from radiation therapy of malignant neoplasms of the chest; the delayed induction of cancer following therapeutic applications of radiation; the relationship between radiation injury and regenerative processes; the effectiveness of certain chemical agents in the therapy of hematopoietic disorders occurring as the result of exposure to ionizing radiation; complications resulting from radiation therapy of benign and malignant tumors and non-neoplastic diseases; the significance of bone marrow transfusions in the treatment of radioinduced depression of hematopoiesis; the characteristics of radiation sickness resulting from internal irradiation with β particles from phorphorus-32; and problems in the development of radiation hygiene. (C.H.)

28754 (JPRS-13953) RECENT SOVIET WORK IN MEDICAL CHEMISTRY. Translation of Voprosy Med. Khim., 8: No. 1, 3-19(1962). 48p.

Translations are included of two selected articles. An abstract has been prepared for one. The title of the other article is: Biosynthesis and Fibrillogenesis of Collagen Proteins. (C.H.)

28755 (JPRS-13953(p.39-47)) DISTURBANCE OF THE METABOLISM OF TISSUE IRON IN LIVER FROM IRRADIATED MICE. G. V. Voskoboinikov (Voskoboynikov). Translated from Voprosy Med. Khim., 8: No. 1, 17-19 (1962).

Mice were twice injected subcutaneously with 2.5 μc of Fe^{59} at a 3-day interval. Ten days following the second injection one group of mice was subjected to irradiation and the other group served as the control. Determination of Fe content in the liver demonstrated that irradiation induced a distinct increase both in the total amount of nonhemoglobin tissue Fe and of the content of Fe in the ferritin fraction of liver. At the same time the total radioactivity of the liver Fe and of the fraction decreased in the irradiated animals. The radioactivity of these fractions was shown to be significantly higher than in the liver of nonirradiated animals. It is concluded that the excess accumulation of Fe in the liver of mice during the first two weeks following irradiation takes place predominantly as the result of the removal of Fe from the alimentary tract. (C.H.)

28756 (JPRS-14833) FERTILITY OF MALE MICE EXPOSED TO GAMMA RADIATION DURING EMBRYONIC GROWTH AND THE VIABILITY OF THEIR OFFSPRING.

F. B. Shapiro. Translated from Nauch. Doklady Vysshei Shkoly. Biol. Nauki, No. 2, 104-8(1962). 14p.

Female mice received a single whole-body gamma dose of 50 r on the 12 and 16th day of pregnancy. Following irradiation, the pregnant females were separated and placed in individual cages and investigations were conducted on their male offspring. At 3.5 to 4 months, the males were cross-bred with females of the same age. The data indicate that gamma irradiation of male mice with a dose of 50 r during the period of embryonic growth results in a serious disturbance of fertility. The disturbance manifests itself both in a complete sterility and in a lowering of reproductive ability and in a smaller size of litters. The irradiated males also differ from control animals in a poorer capacity for cross-breeding, while their offspring are characterized by a poorer viability and a lower weight in comparison to baby mice of the same age from control litters. (P.C.H.)

28757 EARLY BONE MARROW HEMORRHAGE IN THE IRRADIATED DOG. V. P. Bond, T. M. Fliedner, and E. Usenik (Brookhaven National Lab., Upton, N. Y.). A.M.A. Arch. Pathol., 73: 13-29(Jan. 1962).

Dogs were exposed to 275, 400, or 600 r of x irradiation, and sections of ribs obtained serially were examined histologically. At all dose levels disruption of the marrow sinusoids and of the architecture was noted within hours of exposure, with extravasation of blood into the parenchyma and frank bone marrow hemorrhage by 24 hours. The disruption of architecture was paralleled by depletion of the cells, either through direct cell death (pyknosis, karyorrhexis) or through the development of mitotically connected abnormal forms. The bone marrow hemorrhage occurred well before the time that circulating platelet depletion is observed at the dose levels employed. Possible mechanisms of the hemorrhage are discussed. The pattern of regeneration in the marrow of surviving animals is described and discussed. (auth)

28758 DEVELOPMENT OF CHICK EMBRYO GONADS GRAFTED IN A HOST EMBRYO AFTER TREATMENT IN CULTURE BY X RAYS. B. Salzgeber (College de France, Nogent). Acta Anat., 47: 388(1961). (In French)

Cultures of chick embryo ovary and testis were irradiated with 1600 to 12,450 r, transplanted to the coelom of young embryos after various intervals, and allowed to develop for 10 to 12 days. Some grafts degenerated; others developed abnormally. The ovarian cortex was particularly sensitive and usually underwent destruction. In some instances the irradiated ovary was reduced entirely to medullary constituents enclosed by large lacunar structures. The seminiferous tubules of testis became disorganized. Endocrine activity of irradiated, transplanted gonads was assessed by their effect on genital structures of the host embryo. Male and female gonads showed differences in sensitivity of their endocrine cells to irradiation. Irradiated ovaries retained their hormonal activity and, as in controls, caused feminization of male host embryo. In contrast, testes submitted to high doses of radiation showed impaired hormone secretion as seen by their inability to cause regression if Mullerian duct in female host embryos. (H.H.D.)

28759 SOME NEW DATA CONCERNING THE FUNCTIONAL UNITY OF THE LYMPHATIC SYSTEM. G. Csaba, I. Toro, and Katalin Mold (Medical Univ., Budapest). Acta Anat., 48: 114-21(1962). (In English)

Adult male rats were submitted to 400- or 700-r whole-body radiation and 1 or 4 days later portions of thymus, spleen, and lymph nodes were removed and cultured in vitro. Some nonirradiated animals were injected with an antigen (ovalbumin) and in some cases the tissues were cultured in the presence of heparin. Both irradiation and immunization increased the number of mast cells in thymus. Since culturing thymus cells in the presence of heparin also stimulates their formation, it is suggested that irradiation acts in this way by causing release of heparin in thymus. Irradiation destroyed plasma cells almost completely in thymus but less extensively in spleen and lymph node. However, irradiation impaired the growth of lymph node to a much greater extent than that of thymus. The presence of heparin in the medium further inhibited the growth of irradiated lymph node but stimulated that of irradiated thymus. The results show that these 3 component tissues of the lymphatic system have different functions and sensitivity; spleen and lymph nodes are concerned primarily with development of plasma cells whereas thymus is less sensitive and an important source of mast cells. (H.H.D.)

28760 ACTION OF X RAYS ON EMBRYONIC GONADS OF THE CHICK CULTURED IN VITRO. B. Salzgeber (College de France, Nogent). Acta Anat., 48: 184(1962). (In French)

Ovaries and testes of chick embryos explanted in vitro were submitted to 1600- to 12,450-r irradiation, transferred to fresh medium, and cultured for 4 to 10 days longer. The irradiated cultures appeared grossly normal but histologic examination clearly revealed abnormalities. In the most abnormal cultures, sexual differentiation of the gonads was lacking and male and female gonads were indistinguishable. The ovarian cortex disappeared and only the medulla remained in reduced and vacuolated form; many nuclei were pyknotic but some apparently normal cells escaped radiation damage. With weak doses (3000 r) the ovarian Pflüger tubes showed evidence of complete or partial sterility. Testicular structures were correspondingly modified; the seminiferous tubules were disorganized, underdeveloped, sometimes destroyed, and often replaced by undifferentiated tissue composed of vacuoles and normal cells. When these irradiated gonads were transplanted in host embryos, their development proceeded as it had in vitro, leading to abnormal structures. Besides degenerative changes, the ovaries showed involution of cortical tissue and leukocytic infiltration of medullary tissue. Testes underwent destruction at high radiation doses and, in general, the male gonad showed higher sensitivity than the female gonad to radiation. (H.H.D.)

28761 STUDIES OF TOTAL-BODY IRRADIATION AND ATTEMPTED MARROW TRANSPLANTATION IN ACUTE LEUKEMIA. Gould A. Andrews, Beecher W. Sitterson, Arthur L. Kretchmar, and Ryosaku Tanida (Oak Ridge Inst. of Nuclear Studies, Tenn.). Acta Haematol., 26: 129-53 (1961). (In English)

A summary of current impressions on the treatment of leukemia by irradiation and bone marrow grafting is presented. Total-body irradiation alone produces remissions in some cases of acute leukemia. Remissions alone cannot be accepted as proof of survival of attempted marrow grafts. In most cases of acute leukemia the leukemic cells appear to be radiosensitive and there is profound cell destruction after a single large dose of radiation. This cell destruction may contribute to early death of some patients. Even when it appears that all the cells have been destroyed, exacerbation of the leukemia occurs later. The term marrow ablation should be used very carefully. Many patients who survive a single dose of radiation or marrow-damaging drug have gone through a phase of apparent marrow ablation. In the leukemic patient who responds favorably to total-body irradiation, the phase of marrow recovery be-

gins about two weeks earlier than in normal patients exposed to the same radiation dose. An explanation for this fact would probably have general importance. (auth)

28762 EFFECTS OF RADIATION AND MUTAGENIC CHEMICALS ON GROWTH AND SURVIVAL IN ITALIAN VARIETIES OF DURUM WHEAT. S. Avanzi (CNEN, Rome). Atti assoc. genet. ital., 6: 353-64(1961). (CNEN-124). (In Italian)

A study was made on the comparative effects of radiations (x rays, thermal neutrons, fast neutrons) and of three chemical substances (β-propiolactone, ethylene chloride, diethyl sulfate) on seedling growth and plant survival in the field in the durum wheat varieties Aziziah, Cappelli, and Russello. In agreement with previous investigations on barley, it was found that both thermal and fast neutrons are able to inhibit root growth more strongly than shoot growth, whilst an almost identical degree of growth inhibition is observed in the two organs with x rays and chemicals. Maximum depressing effect was observed in the thermal neutron series. As to field survival, clear differences between thermal and fast neutrons on one side and x rays and chemicals on the other were seen. Only a fraction of seedlings was able to survive to maturity in thermal neutron treated material. Among the three varieties investigated, Aziziah was found as the most radiosensitive one. No statistical difference in radiation sensitivity was found between Cappelli and Russello. Response to chemicals of Cappelli and Aziziah varied according to type of treatment and effect studied. With ethylene chloride, Cappelli was more sensible than Aziziah as to seedling growth and more resistant as to field survival. With β-propiolactone and diethyl sulfate, Cappelli was more affected than Aziziah in both field survival and seedling growth. (auth)

28763 EFFECT OF TREATMENT WITH X RAYS COMBINED WITH AIR, NITROGEN, AND OXYGEN IN DROSOPHILA MELANOGASTER STUDIED USING SEX-LINKED LETHAL RECESSIVES. L. V. Pozzi, S. Giavelli, G. P. Sironi, and E. Gallucci (Università, Milan). Atti assoc. genet. ital., 7: 170-9(1962). (RT/BIO(62)45). (In Italian)

Germ cells of spermatogenesis of D. melanogaster were treated with 600 r x rays. The sensitivity spectrum for recessive sex-linked lethals, obtained by crossing the treated males for 12 successive days, showed a maximum in days 5-7, corresponding to treated spermatids. Anoxia lowered the sensitivity throughout the whole spectrum, particularly for spermatids; O_2 treatment increased x ray damage, although not uniformly in the different stages of spermatogenesis: the less sensitive cells under the circumstances were spermatids and spermatogonia. (auth)

28764 FIRST RESULTS ON X-RAY-INDUCED GENETIC DAMAGE IN ARTEMIA SALINA LEECH. E. Ballardin and P. Metalli (Università, Milan). Atti assoc. genet. ital., 7: 219-31(1962). (In English)

Prophase oocytes of diploid and tetraploid parthenogenetic Artemia salina were x irradiated with 1000 r and damage was scored as oocyte or embryo lethal mutations at the first (X_1) and at the second (X_2) generations after irradiation. Dominant lethality shown at X_1 was much greater for the diploid strain than for the tetraploid; lethality observed at X_2 was increased with respect to X_1 in the diploid strain, while in the tetraploid one it remained unmodified. (auth)

28765 EFFECTS OF TEMPERATURE ON THE FREQUENCY OF SOMATIC MUTATIONS INDUCED BY X RAYS IN MAIZE SEEDLINGS. A. Bianchi and M. Contin (Università, Milan). Atti assoc. genet. ital., 7: 240-9(1962). (RT/BIO(62)44). (In Italian)

The frequency of yellow-green sectors on the green background of maize seedlings heterozygous Yg_2/yg_2 (yg_2 = yellow-green-2 on short arm of chromosome 9) was used as a criterion of measuring somatic mutation rate induced by x irradiation (3-8 kr) on seeds possessing 4 (dry seeds) or 11% (normal seeds) water content at different temperatures. With dry seeds the mutation rate was the same at −70 and 20°C, but dropped significantly and linearly passing from 20 to 30°, 50 and 65°C. Such decreases were great for the third leaf, moderate for leaf four, and slight for leaf five. In seedlings sprouted from seed irradiated with 11% moisture content, the sensitivity plateau of the dry seeds, between −70 and 20°C was missing, since the mutation rate of 20°C was already clearly decreased as compared with that of −70°C. (auth)

28766 RESEARCH ON THE POLYGENIC MUTABILITY INDUCED IN MAIZE. D. L. Palenzona and S. Scossiroli (Università, Pavia, Italy). Atti assoc. genet. ital., 7: 257-65(1962). (RT/BIO(62)49). (In Italian)

An analysis of data concerning an R_3 population of maize shows an amount of genetic variability greater than expected is found to be present in control (nonirradiated) population, if the experimental material is considered in an autodiploid strain. Comparison between different estimates of variance suggest that a mutagenic effect of ionizing radiations may be involved. Several types of selections are probably responsible for the situation described, and it is possible that different responses shown by different traits at the same dose are due to the selective forces. (auth)

28767 EFFECTS OF CHRONIC GAMMA IRRADIATION IN CULTURAL VARIETIES OF VULGARE AND DURUM WHEAT. G. T. Scarascia, B. Donini, and F. D'Amato (Comitato Nazionale Energia Nucleare, Rome). Atti. assoc. genet. ital., 7: 279-80(1962). (RT/BIO(62)43). (In Italian)

The effects of chronic gamma radiation on five varieties of vulgare wheat (Brescia, Mara, San Pastore, Terminillo, and Turaro) and five varieties of durum wheat (Aziziah, Capeiti, Cappelli, Grifoni, and Russello) were studied. Dose rates of 420, 255, 148, and 72 r per 20-hr day were tested and plant irradiation was started at the 5-leaf stage. No survival to maturity occurred in any of the varieties at the daily doses of 420 and 255 r. With the daily doses of 148 and 72 r, not affecting survival consistently, two striking growth responses were observed: increase in the mean number of culms per plant; and increase in the mean weight per mature plant. (auth)

28768 EXPERIMENTAL RADIATION DAMAGE OF THE CEREBELLUM OF THE MOUSE AFTER HIGH DOSAGE ROENTGEN IRRADIATION. (A STUDY WITH NEUROHISTOLOGIC IMPREGNATION PROCEDURES). N. Schuemmelfeder, M. Dobbert, and H.-D. Bergeder (Univ. of Bonn). Beitr. pathol. Anat. allgem. Pathol., 126: 170-93(1962).

The cerebellum was irradiated with a single dose of 10 or 60 kr delivered at a rate of 3.7 kr/min, the rest of the animal being shielded. No gross effects were noted with the low dose but with the high dose the animals died within 6 hr to 5 days. Six to 8 hr after the high dose, the meninges appeared red but no other gross changes of the brain were evident. However, histopathologic changes could be noted as early as 2 hr after 60 kr, especially with Ag and Au impregnation techniques. The earliest change was noted in the nerve cells of the most superficial molecular layer

of cerebellum and appeared as swelling of nucleus and cytoplasm. Then followed similar changes and pyknosis in the granular layer, and later the Purkinje cells showed these changes. The tissue became vacuolated, taking on a spongy or honeycomb appearance, and by 10 hr after irradiation, necrosis was so extensive that cellular elements were obliterated and no longer recognizable. After 10-kr irradiation, similar but less extensive necrosis of nerve cells occurred. Examination of cerebellum several months later showed widespread destruction of ganglion cells and replacement by microglial elements; proliferation of macroglia and a coarsening of epithelial fiber processes in the molecular layer were also evident. After 120 days the damaged regions of cerebellum showed a cell-poor, fiber-rich scar in which macroglia were prominent. Blood vessels were dilated and their walls thickened. (H.H.D.)

28769 THE EFFECT OF CYTOTOXIC AGENTS ON THE PRODUCTION OF ANTIBODY TO T.A.B. VACCINE IN THE MOUSE. M. C. Berenbaum (Glaxo Labs. Ltd., Greenford, Eng.). Biochem. Pharmacol., 11: 29-44(1962).

Mice were given single injections of typhoid-paratyphoid vaccine and nitrogen mustard, triethylene melamine, Myleran, 6-mercaptopurine, 6-thioguanine, or amethopterin, or a single irradiation. It was found that irradiation and Myleran suppressed anitbody production maximally if given about 2 to 4 days before the antigen, whereas the other agents did so when given about 2 days after the antigen. A single dose of agent given at the appropriate time depressed antibody production for some weeks. Once antibody production was well established it was relatively resistant to interference by these agents. These findings suggest the hypothesis that differentation of the cells concerned in the immune response is accompanied by changes in their susceptibility to cytotoxic agents. During early stages of differentiation, before the antigenic stimulus has been received, they are sensitive to irradiation and Myleran. During the stage of differentiation that follows specific antigenic stimulation, they are sensitive to the other agents. When fully differentiated and engaged in producing antibody, they are relatively insensitive to agents of both classes. (auth)

28770 TUMOURS OF THE SKIN AND OTHER DELAYED EFFECTS OF EXTERNAL BETA IRRADIATION OF MICE USING ^{90}Sr AND ^{32}P. E. V. Hulse (Medical Research Council, Harwell, Berks, Eng.). Brit. J. Cancer, 16: 72-86(Mar. 1962).

The histological type and incidence of skin tumors in mice were studied in mice after external beta irradiation from either a P^{32} or a Sr^{90} source. Almost one quarter of the animals exposed to Sr^{90} radiation died of late complications of acute damage to their skin and small intestine. To overcome variations in the amount of skin irradiated the incidence of tumors is expressed as the number per 100 cm^2 of irradiated skin: Squamous-cell carcinomas increased from none in the controls to just under 0.1 per 100 cm^2 in irradiated animals. Fibrosarcomas increased from 0.04 per 100 cm^2 in control mice to 2.0 per 100 cm^2 after doses of 3000 rads and above, i.e., the incidence increased 50 times. Tumor incidence was not correlated with the severity of residual radiation damage of the skin and was about the same in both strains of mice used and in males and females. Radiation induced fibrosarcomas occurred earlier than those occurring in the control animals. Some of the human implications of the data are briefly discussed. (auth)

28771 THE EFFECT OF MINERAL OIL AND POWDERED GLASS ON THE SEX ORGANS OF X-IRRADIATED MALE MICE. M. Maqsood (Univ. of California, Berkeley). Brit. J. Radiol., 35: 628-31(Sept. 1962).

Intraperitoneal administration of 1 ml of either mineral oil or 40 mg of powdered glass (~40 μ) in 1 ml of saline within an hour following a single whole-body exposure to 625 r of x rays ($LD_{50}30$) markedly increased the degenerative changes in the testes and seminal vesicles of the irradiated mice and retarded the rate of cellular regeneration as compared with that observed in the x-irradiated mice. The histological changes in the testes and seminal vesicles of the treated mice followed the changes in the weights of these organs at different time intervals following x irradiation. The administration of mineral oil and powdered glass in the x-irradiated male mice caused a significant decrease in the body weight when compared with that of the x-irradiated group from the 30th to 120th day post-irradiation. (auth)

28772 THE EFFECTS OF X-RADIATION ON THE SUCCINIC DEHYDROGENASE ACTIVITY OF THE DIVIDING STAGES OF TETRAHYMENA PYRIFORMIS GL. William D. Sullivan and James V. Boyle (Boston Coll., Chestnut Hill, Mass.). Brotéria, Sér. cienc. nat., 30: 77-85(1961).

Tetrahymena pyriformis was grown in a chemically defined medium, synchronous division was induced by the temperature flux method, and the succinic dehydrogenase activity was tested by Thunberg technique in both control and irradiated cultures of each stage of division. The control cultures immediately after the shock treatment and 150 minutes after the treatment (during the actual division of the cell) manifested a significant inhibition ($P < 0.05$) of enzyme activity. In these same stages activity was accelerated when the organisms were irradiated. (auth)

28773 EFFECT OF MODERATE DOSES OF GAMMA RADIATION ON THE KEEPING QUALITY OF BILBERRIES (VACCINIUM MYRTILLUS). A. Horubała and E. Pijanowski (Dept. of Food Agricultural Ind., Warsaw). Bull. Acad. Polon. Sci., Ser. Sci. Biol., 9: 167-71(1961). (In English)

Three batches of bilberries (European blueberries) in small polythene bags were treated with various doses of γ radiation and kept afterwards either at ambient or cool storage temperatures for about 10 to 25 days. The dose of about 0.3 Mrad caused the destruction of somewhat more than 99% of the original microflora (bacteria, yeasts and moulds) and thus increased by 250 to 300% the storage life of berries in comparison with untreated fruit. Losses of anthocyanin pigments, vitamin C, and jellifying power were rather small, and the subsequent changes in flavor were practically non existant. The authors recommend the application of moderate doses of γ-rays (about 0.3 Mrad) to exported bilberries prior to their shipment. (auth)

28774 THE UNCOUPLING OF OXIDATIVE PHOSPHORYLATION BY IONIZING RADIATION. J. F. Scaife and B. Hill (Defence Research Chemical Labs., Ottawa). Can. J. Biochem. and Physiol., 40: 1025-42(Aug. 1962).

Whole-body irradiation of rabbits or rats with x rays or Co^{60} γ rays causes uncoupling of oxidative phosphorylation in thymus mitochondria, which is not prevented by the prior administration of AET. Whole-body irradiation was not found to affect oxidative phosphorylation in liver or mouse ascites cell mitochondria. The radiation lesion can be repaired in vitro by the addition of cytochrome c, bovine serum albumin, or vitamin K_1 to mitochondria. Vitamin E and coenzyme Q_{10} were without effect. Both phosphorylating steps in the electron transport chain associated with succinate oxidation are affected by irradiation. The diphosphopyridine nucleotide dependent steps in the oxidation of

α-ketoglutarate by thymus mitochondria are damaged by in vivo irradiation. Diphosphopyridine nucleotide levels of thymus and spleen but not liver or ascites cells are reduced by in vivo irradiation. No effect of in vitro irradiation on oxidative phosphorylation could be found for thymocyte cell suspensions, isolated thymus or liver mitochondria, or ascites or HeLa cell suspensions. Respiration of ascites or thymocyte cells was unaffected by in vitro irradiation. (auth)

28775 MUTATION FREQUENCIES IN BARLEY AFTER TREATMENT WITH γ-RADIATION, ETHYLENE IMINE, ETHYL METHANESULFONATE AND MALEIC HYDRAZIDE. T. J. Arnason, Laila Mohammed, Donna Koehler, and F. M. Renneberg (Univ. of Saskatchewan, Saskatoon, Can.). Can. J. Genet. Cytol., 4: No. 2, 172-8(June 1962).

The frequency of mutations affecting chloroplastids and their pigments in barley after treatment with γ-radiation, ethylene imine, ethyl methanesulfonate and maleic hydrazide was investigated. Some combinations of chemicals or of chemicals and radiation were also used. Of 14,000 spikes of untreated barley only 11 had new chlorophyll mutations. The mutation frequency per spike was 0.0007. When dry grains were irradiated with small doses of γ-rays the results indicated that the doubling dose was in the 25 to 100 r range. With the largest radiation dose, 10,800 r, the mutation frequency per 100 spikes was 6.1. The effectiveness of each r of dose in inducing transmissible mutations appeared to decline as the dose was increased. Seeds soaked in adenine-thymine solutions for some hours before and after irradiation yielded fewer mutations than did irradiated water-soaked seeds. The highest mutation frequency obtained in experiments with ethylene imine alone was 20.5%. When seeds were treated with both ethylene imine and adenine thymine solutions the mutation frequency rose to 23.8%. These substances when combined may have a synergistic effect. Ethyl methanesulfonate was the most effective of the tested mutagens, giving a maximal frequency of 39.8% mutant spikes. Maleic hydrazide solutions induced very few mutations in the embryos of barley seeds. The compound exerted a slight protective effect when applied prior to γ-irradiation treatment. (auth)

28776 RADIOSENSITIVITY TO NEUTRONS OF FERTILIZED EGGS OF URODELIA. Louis Gallien and Monique Labrousse. Compt. rend., 255: 371-3(July 9, 1962). (In French)

In the fertilized egg of Pleurodeles waltlii after neutron irradiation, there is a maximum radiosensitive stage at the moment of the mitosis of the first segmentation division and a minimum radiosensitive stage after the emission of the second polar corpuscle. These effects were established for a definite intensity of radiation acting for a given time. (tr-auth)

28777 INVESTIGATIONS ON THE COMPARATIVE ACTION OF CYCLOPHOSPHOAMIDE (ENDOXAN) AND X RADIATION ON THE MEDULLARY CELLS IN THE RAT. A. Chevallier, S. Manuel, and D. Chateau (Faculte de Medecine, Strasbourg). Compt. rend. soc. biol., 156: 372-5 (1962). (In French)

Under the experimental conditions very sharp differences were noted between the effects of Endoxan and x radiation. X radiation causes a more rapid and more brutal destruction of cellular elements than that caused by Endoxan. With respect to restoration, it is also more rapid and more complete with x rays than Endoxan. It is necessary, moreover, to note that the impregnation of the organism with Endoxan using fractionated doses seems to reduce considerably the effect of this chemical. (tr-auth)

28778 STUDY OF THE COMBINED ACTIONS OF CYCLOPHOSPHOAMIDE (ENDOXAN) AND OF X RADIATION ON MEDULLARY CELLS IN THE RAT. A. Chevallier, S. Manuel, and D. Chateau (Faculte de Medecine, Strasbourg). Compt. rend. soc. biol., 156: 376-9(1962). (In French)

A study was made to determine a possible partial or total summation of the action of x radiation and Endoxan acting simultaneously or in various combinations in the medullary cells in the rat. The fact that there is no symmetry between the actions of the physical agent and the chemical agent indicates that their biological effects, observed with respect to the same tests, are not identical. The results obtained as a result of various methods of administration show that the effect resulting from the combination of these two agents is more marked when the irradiation precedes the administration of Endoxan. On the contrary, the action of Endoxan, administered before irradiation, sharply decreases the radiation effects. The maximum effect seems to be obtained by the administration of both agents on the same day. These conclusions are valid only with respect to the biological tests used, the medullary cells of the normal rat. (tr-auth)

28779 IMMEDIATE EFFECTS OF X RAYS ON THE HEART OF CHICKEN EMBRYOS. Claude Onkelinx (Université, Liege and Laboratoire de Recherches pour la Protection des Populations Civiles, Liège). Compt. rend. soc. biol., 156: 393-6(1962). (In French)

The heart of the chicken embryo, at the stage of 80 to 88 hours of incubation, accelerates immediately the rhythm of its contractions when it is irradiated in situ with an x-ray beam of very high output; this acceleration is rapidly followed by slowing and arythmia. These facts suggest a stimulating effect for x rays preceding their depressant effect. (tr-auth)

28780 EFFECTS OF CONTINUOUS LOW LEVEL COBALT 60 GAMMA RADIATION ON A MAMMALIAN CELL SYSTEM. Alfred Hellman (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 28(July 1962).

A reliable method for the rapid detection of continuous low level gamma radiation effects on a biological system in vitro and its use for the screening of potential radiation protective agents was studied. L-M mouse cells growing as uniformly dispersed suspension in a simplified medium were used as the biological indicator of continuous radiation effects. Growth curve analysis indicated that the most consistent and readily detectable responses to long term irradiation were generation time and total population density differences of the irradiated culture as compared to the normal control. Although DNA, RNA, DNase II, and protein determinations were made of the irradiated and control cultures, the only reproducible change at the molecular level which was detected in the irradiated culture was an increase in DNase II activity. On the basis of morphological and physiological observations, it is postulated that continuous low level gamma irradiation of L-M mouse cells produces the following sequence of events: increase in generation time; inhibition of cytoplasmic division without inhibition of nuclear division; inhibition of nuclear and cytoplasmic division; and ultimate cell death. Exposure of L-M cell cultures to 4.8 r/hr over a 7 day period caused an increased generation time of approximately 14 hours over that of the control. After a subsequent 8.5 hour rest period, the initially irradiated culture responded to a re-irradiation as a culture that had never been exposed to radiation. This apparent recovery could be demonstrated in cultures exposed to 1700 r or less cumulative dose. Be-

yond the cumulative dose the cell culture did not recover fully as indicated by an increase in cell size, progressive increase in generation time, and decreased final population density over that of the control cultures. Reduction in incubation temperature from 35 to 30°C significantly enhanced the radiation effects; tripling the generation time and appreciably lengthening the lag phase of the irradiated cultures. Catalase did not protect L-M cells from gamma irradiation, although it neutralized added hydrogen peroxide, indicating that radiation damage was most likely due to intracellular events and not appreciably influenced by extracellular peroxides. Aminoethylisothiouronium bromide and chloride as well as guanidinoethylamine did provide some degree of protection against the effects of continuous low level irradiation, whereas fructose and cysteine did not. It was postulated that one of the requirements for a radiation protective agent is its presence intracellularly for a relatively long time period. (auth)

28781 THE RADIATION SENSITIVITY OF WHOLE ORGANISMS AND THE SENSITIVITY OF THE CHROMOSOME SYSTEM IN "IN VITRO" CELLS. Yu. Ya. Kerkis, L. I. Lebedeva, and T. D. Osetrova (Inst. of Cytology and Genetics of the Siberian Branch, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1165-7(1962). (In Russian)

In order to clarify the controlling mechanism of radiation sensitivity, comparisons were made between the overall radiation sensitivity of whole organisms and the sensitivity of chromosomes in individual cells in tissue cultures. In studying the radiation sensitivity of the hamster (with an average lethal dose $LD_{50/30} \cong 900$ r), the rabbit ($LD_{50/30} \cong 800$ r), and the guinea pig ($LD_{50/30} \cong 400$ r, – close to that of man), it was found that the increase of the lethal dose is always increased by an increase of the resistivity of the chromosomes. This might be of interest for determining the radiation sensitivity of humans. Therefore, the frequency of chromosome reorganization in the tissue cultures of the fibroblasts of human, rabbit and hamster embryos was studied after exposure to x rays in the dose range from 10 to 200 r. It was found that the amount of tissue with incipient chromose reorganization was smallest for the human tissue (0.141%), followed by the rabbit (0.058%) and the hamster (0.036%) tissue. The sensitivity of the chromosomes in the human tissue was thus 3.6 and 2.7 times higher than for the other two mammals, reflecting the radiation sensitivity of the whole organisms. The use of tissue culture technique for determining radiation sensitivity of man is thus justified. The experiments also indicated that the probable upper limit of the dose causing a doubling of the spontaneous mutation frequency for humans is not more than 10 r. (TTT)

28782 MORPHOLOGICAL CHANGES PRODUCED BY GAMMA RADIATION ON THE SPOROGONOUS CYCLE OF PLASMODIUM GALLINACEUM. Levon A. Terzian (Naval Medical Research Inst., Bethesda, Md.). Expti. Parasitol., 11: 102-10(Sept. 1961).

It has been shown that gamma radiation administered to the sporogonous cycle of the malarial parasite Plasmodium gallinaceum inhibits its normal development within the host mosquito Aedes aegypti. The morphological changes which occur in the parasite in vivo, as a consequence of the exposure to radiation, have been described in some detail, and are demonstrated in part in the photographs which accompany the text. A certain proportion of the parasites survive exposure to 5,000, 10,000, and 15,000 r and complete their normal development to produce viable, infective sporozoites even though the rate of development may be retarded to a lesser or greater extent. None of the parasites, however, survives exposure to 20,000 r or more. Regardless of the amount of radiation that has been administered, vacuole formation around the k-granule of the parasite appears uniformly as the first, and for a time, as the only specific morphological effect resulting from the exposure to radiation. The Brownian-like motion of the parasite granules which typically occurs in degenerating drug-treated parasites has been found to occur also in parasites exposed to gamma radiation. (auth)

28783 TOLERANCE OF ERYTHROCYTES IN POULTRY: INDUCTION AND SPECIFICITY. N. A. Mitchison (Univ. of Edinburgh, Scotland). Immunology, 5: 341-58 (May 1962).

Chickens could be rendered immunologically tolerant to foreign cells (homologous and turkey erythrocytes) by a series of transfusions of x-irradiated foreign blood. Development of tolerance was evaluated by the rate of elimination of the Cr^{51}-labeled erythrocytes. Transfusions were begun in the embryo via chorioallantoic vein and continued in the newly hatched chick. Blood irradiated with 10,000 to 40,000 r induced tolerance, but with larger doses (100,000) tolerance was not conferred. Irradiation damaged the erythrocytes slightly but the degree of damage was not correlated with survival time of the transfused cells. The results show that irradiation of blood injures leukocytes more extensively than erythrocytes, since it was previously found that 10,000 r abolished the ability of blood to induce graft-versus-host reactions. Tolerance induced with irradiated blood is generally incomplete but may last indefinitely; however, tolerance acquired in this way is less stable and complete than tolerance acquired from nonirradiated, viable cells. On the other hand, viable cells provide a less sensitive test, since birds which tolerate skin homografts often rapidly eliminate erythrocytes from the same donor. (H.H.D.)

28784 A SURVEY OF THE EFFECT OF METABOLIC ANTAGONISTS ON THE SYNTHESIS OF ANTIBODY IN AN IN VITRO SYSTEM. R. W. Dutton and Jennifer D. Pearce (Postgraduate Medical School, London). Immunology, 5: 414-23(1962).

Rabbits previously immunized to 2 antigens (ovalbumin and horse γ-globulin) were restimulated by injection of 1 antigen followed, 1 day later, by the 2nd. A cell suspension of their spleens was prepared 2 days after injection of the 2nd antigen and the effects of x irradiation and metabolic antagonists on antibody synthesis were studied. Control spleen cells synthesized both antibodies simultaneously when incubated in vitro. Irradiation of the cells before incubation inhibited antibody synthesis; the required dose for 50% inhibition varied from 120 to 800 rads. Irradiation markedly reduced cell viability, as little as 50 rads reducing cell survival to 48 hr to less than half that of nonirradiated cells. Cells from different rabbits showed wide variations in radiosensitivity. It was considered that radiation inhibited antibody synthesis as a result of cell death. A similar cause of inhibition was apparent with cells treated with mitomycin C, ethidium bromide, 6-mercaptopurine, 5,6-dichlorobenzimidazole riboside, and 6-thioguanosine, but a more selective inhibition was produced by thymidine analogs, 6-azauridine, and colchicine. (H.H.D.)

28785 X IRRADIATION AND TOXIN NEUTRALIZATION BY ANTITOXIN. Reuben L. Kahn, Sun Hyoo Kim, Arthur C. Curtis, and Charles S. Simons (Univ. of Michigan, Ann Arbor). J. Infectious Diseases, 107: 325-31(Nov.–Dec. 1960).

A small area of the skin of normal rabbits was exposed to 1000 r and, after a given interval, 15 units of horse serum diphtheria antitoxin were injected subcutaneously in that area and simultaneously a lethal (25 MLD) dose of homologous toxin in another area. As controls, non-irradiated rabbits of similar weight were injected with the same quantities of antitoxin and of toxin at the same time as the irradiated rabbits and under identical conditions. Five intervals following the irradiation were employed for the injection of the antitoxin and the toxin: 1 to 3 hours, 24 hours, 7 days, 14 days, and 90 days. It was found that, of the irradiated rabbits, 55% survived the toxin when the antitoxin was injected 1 to 3 hours after the exposure, 100% survived when the antitoxin was injected 24 hours after, 47% survived when the antitoxin was injected 7 days after, 27% survived when the antitoxin was injected 14 days after and none of the rabbits survived when the antitoxin was injected 90 days after. Of the non-irradiated controls, an average of 20% survived the toxin. The results indicated that a restricted amount of antitoxin injected subcutaneously in an irradiated area up to 7 days after exposure to 1000 r was more effective in the neutralization of a lethal dose of toxin than the same amount injected into a corresponding area of non-irradiated rabbits and the most marked neutralization occurred 24 hours after the exposure. By 14 days after the exposure, the neutralization of the toxin reached the control level, but 90 days after, no neutralization of the toxin was observed. The basis for the non-neutralization of the toxin in any of the rabbits was apparently not an insufficiency of the subcutaneously-injected antitoxin, which consisted of 15 units, since 5 units injected intravenously were found to be ample for neutralization of the same dose of toxin. The non-protection was due most likely to the localization of the proteins of the antitoxin, consisting of 0.75 mg, in the area of injection, preventing thereby the antitoxic fraction from reaching the toxin in time for neutralization. When the 15 units of antitoxin were injected in the irradiated area 1 to 3 hours after exposure to 1000 r, 45% of the rabbits showed localization of the protein. None of the rabbits showed localization when injected 24 hours after, 53% showed localization when injected 7 days after, 73% showed localization when injected 14 days after and 100% showed localization of the 0.75 mg protein when injected 90 days after the exposure to 1000 r. With regard to the controls, an average of 80% of the non-irradiated rabbits localized this fraction of a milligram of protein in the subcutaneously injected area. Localization in these experiments was undoubtedly temporary in nature, preceding proteolysis. But the length of time of localization was apparently sufficient to so retain the antitoxic fraction in the injected area as to prevent it from reaching and neutralizing the toxin. (auth)

28786 MOLECULAR RADIOBIOLOGY OF HUMAN CELL LINES. II. EFFECTS OF THYMIDINE REPLACEMENT BY HALOGENATED ANALOGS ON CELL INACTIVATION BY DECAY OF INCORPORATED RADIOPHOSPHORUS. G. Ragni and Waclaw Szybalski (Univ of Wisconsin, Madison). J. Mol. Biol., 4: 338-46(May 1962).

A comparison was made of the intrinsic sensitivities to P^{32} decay of bacteriophage and bacterial deoxyribonucleic acid (DNA) with that of the more complex, diploid (or hyperdiploid) mammalian cells. The experiments throw new light on the nature of the P^{32}-DNA inactivation process and also confirm earlier notions on the mechanism of the radiosensitization of DNA halogenation. Compared with bacteria or phages, human cells were found to be highly resistant to this type of inactivation, with cell death ensuing after 4000 P^{32} to S^{32} transmutation events within the DNA complement of the cell (efficiency of killing, $\alpha = 2.4 \times 10^{-4}$). Incorporation of thymidine analogs, 5-chloro-, 5-bromo-, and 5-iododeoxyuridine (CUdR, BUdR, and IUdR), into the cell DNA increases the sensitivity to P^{32}-decay inactivation by a factor of 2.1 (CUdR and BUdR) to 3.3 (IUdR) under the experimental conditions employed (60% thymidine replaced by the analogs). Studies on the mechanism of the phenomenon revealed that enhancement of the cell's sensitivity to the lethal effects of P^{32} decay requires that the halogen atoms be incorporated into the strand opposite to that bearing the P^{32} atoms. In other words, unifilar halogen labeling of the same DNA strand as that bearing the P^{32} atoms, while the other strand remains unlabeled (achieved by placing the cells in P^{32}- and BUdR-containing medium for only one round of DNA replication), does not alter the rate of cells inactivation observed with unifilar P^{32} labeling alone. These data indicate that scissions through both strands of the DNA molecule constitute the lethal events, and that the halogen, by its electrostatic interaction with the proximate P atom labilizes the phosphate-ester bond, and thus enhances the probability of the double chain scission event. The low killing efficiency of DNA-incorporated P^{32} for mammalian cells indicates either that the double scission occurs only rarely in the vulnerable regions of the DNA complement, i.e., those regions indispensable for cell growth under tissue culture conditions or that some very effective mechanism exists for repair of a constant fraction of the molecular lesions or for annulment of their lethal consequences by other means. (H.H.D.)

28787 THE EFFECT OF GAMMA RADIATION ON THE FIBRINOLYTIC SYSTEM OF DOG LUNG AND ITS MODIFICATION BY CERTAIN DRUGS: RELATIONSHIP TO RADIATION PNEUMONITIS AND HYALINE MEMBRANE FORMATION IN LUNG. William H. Fleming, Jeno E. Szakacs, and E. Richard King (U. S. Naval Hospital, Bethesda, Md.). J. Nuclear Med., 3: 341-51(Sept. 1962).

The pathogenesis of radiation pneumonitis is associated with defective lung plasminogen activation. This defect appears by the end of the first post-radiation week in dog lungs which have been exposed to 1,500 to 2,000 rad Co^{60} gamma radiation. With the lung's fibrinolytic system thus paralyzed, fibrin deposits persist leading to hyaline membrane formation, and ultimately, fibrosis of the lung. Cortisone and heparin in the doses employed, failed to protect or potentiate, the effects of Co^{60} gamma radiation on the histology and activator enzymes of dog lungs. Heparin did seem to diminish fibrin deposition, however, sufficient histologic defects persisted to allow one to diagnose radiation pneumonitis. Actinomycin D, 15 μg/kg, administered intravenously just prior to, and for four subsequent post-radiation days, fully protected the lungs of four 10-kg dogs given 2,000 rad to the right hemithorax. Histologically, these lungs were completely normal and lung plasminogen activator was readily detectable in all. The mechanism of this protective action of actinomycin D is not presently understood. (auth)

28788 ANALYSIS OF A RADIATION-INDUCED MUTATION IN E. COLI. Joseph Engelberg (Univ. of Kentucky, Lexington). J. Theoret. Biol., 2: 312-25(May 1962).

Mathematical expressions are derived which relate cell death and mutation resulting from irradiation. It is assumed that cell death and mutation are both one-hit processes and statistically independent, i.e., cell killing and mutagenesis are represented within a cell as two separate, non-overlapping targets. The derived expressions were

applied to the experimental data of Demerac and Latarjet (Cold Spring Harbor Symposia Quant. Biol., 11: 38(1946)) reporting the x-irradiation-induced mutation of Escherichia coli B/r to T1 bacteriophage resistance. For this system the site for killing the cell was calculated to be 55,000 times larger than the mutational site. On the assumption that each bacterial cell contains 3×10^{-14} g deoxyribonucleic acid, it was estimated that the mutational site consists of ~500 nucleotide pairs. This value agrees well with estimates of gene size obtained by other methods. The results confirmed that mutagenesis in this system is a one-hit process at low x-ray doses, but did not rule out the possibility that more complex mutational events may also occur to a small extent. (H.H.D.)

28789 DOUBLING DOSE FOR POLYGENIC MUTATIONS IN DROSOPHILA MELANOGASTER. Yukio Yamada and Osamu Kitagawa (National Inst. of Genetics, Misima, Japan). Japan J. Genetics, 36: 76-83(Apr. 1961). (In English)

Effects of x irradiation upon bristle numbers in Drosophila were remarkable for increasing variances but no increase or decrease was observed for the means. This suggests that the chaeta characters in Drosophila are controlled by neutral genes and the cause of variance increase must be due to induced polygenic mutations. The doubling doses for polygenes involving the chaeta characters were estimated by the two different methods, i.e., isogenisation and selection. They are estimated to be 58 r and 29 r respectively for abdominal and sternopleural bristle numbers from the isogenisation experiment and to be 18 r on an average from selection experiments, providing the spontaneous variance increase rates of the traits be 0.005 and 0.001 per generation, respectively. (auth)

28790 RADIATION GENETICS IN WHEAT. VI. BIOLOGICAL EFFECTS OF THERMAL AND FAST NEUTRONS ON DIPLOID WHEAT. Seiji Matsumura (National Inst. of Genetics, Misima, Japan and Kihara Inst. for Biological Research, Yokohama, Japan). Japan J. Genetics, 36: 84-96(Apr. 1961). (In English)

The thermal and fast neutron irradiations of dormant seeds of Triticum monococcum flavescens were conducted in the Japan Atomic Energy Research Institute's Nuclear Reactor, JRR-1, and in the Oak Ridge National Laboratory's accelerator (14 Mev), respectively. The higher the dosage of the thermal and fast neutrons, the more delayed were germination and growth of seedlings. The seeds were almost uniformly injured in each treatment. There was almost no germination at 37.5×10^{12} nvt/cm^2 of thermal neutrons and at 5 krad fast neutrons. Even at about 30×10^{12} nvt/cm^2 and at 2.5 krad the seedlings did not grow and died in early stage. Also the higher the dosage, the more reduced were survival rate, height of mature plants, and seed fertility. The frequency of chromosome aberrations and chlorophyll and other mutations increased with the increase of dosage, as expected. In comparison with the results obtained from x and gamma-irradiations, 1 r equivalent effects of x rays are produced by about 2×10^9 nvt/cm^2 of thermal neutrons for seedling length and seed fertility. Also the 1 r equivalent effects correspond roughly to those of the order of 10^9 nvt/cm^2 for chromosome aberrations and chlorophyll mutations. The relative biological effectiveness (RBE) of fast neutrons to x rays was found to be for germination rate 4, for seedling length 10, for seed fertility 12, for chromosome aberrations 8, and for chlorophyll mutations 10. (auth)

28791 THE IMPORTANCE OF LOCALIZATION AND DIMENSIONS OF IRRADIATION FIELDS IN DISTANCE GAMMATHERAPY. A. V. Kozlova. Med. Radiol., 7, No. 6, 5-13(June 1962). (In Russian)

In distance gammatherapy of malignant tumors of internal organs the distribution of the dose depends on the localization and dimensions of the fields of irradiation. During treatment of patients suffering from cancer of the esophagus, lungs, or urinary bladder requiring the employment of focal doses amounting to 6,000 r and higher, the irradiation of fields measuring 8×10 and 10×15 cm leads to a high radiation loading of a large volume of normal tissues. In the treatment of esophageal cancer there are prevalently narrow long fields, in the treatment of cancer of the lung or urinary bladder, fields of 6×8 cm or smaller. Special attention should be paid to the angle formed by the central beam and horizontal plane, inasmuch as slight changes of the angle may lead to very irregular dose distribution in the region of the tumor. (auth)

28792 OPTIMAL CONDITIONS FOR THE IRRADIATION OF PATIENTS WITH LUNG CANCER IN ROTATIONAL DISTANCE GAMMATHERAPY. I. I. Kornev. Med. Radiol., 7, No. 6, 18-32(June 1962). (In Russian)

Studies were made of the distribution of doses in the rotational method of distance gammatherapy using a cobalt-60 apparatus. The results are presented in the form of isodose curves which clearly illustrate the distribution of the radiation energy in different angles of phantom rotation depending upon the size of the irradiation field and localization of the rotation axis. (auth)

28793 PROTRACTED OBSERVATIONS OVER THE RESULTS OF COMBINED TREATMENT BY PATIENTS SUFFERING FROM THYROID CANCER BY MEANS OF SURGERY, X-RAYS AND RADIOIODINE. D. G. Rokhlin and V. P. Zadvornova. Med. Radiol., 7, No. 6, 36-41(June 1962). (In Russian)

Fifty-four patients affected with cancer of the thyroid gland, the third stage of the disease prevailed, were subjected to combined treatment consisting of operative interference, x-ray treatment, and radioiodine therapy. Due to various causes a radical operation was impossible in the majority of cases. In these instances the cancerous nodes which did not adhere to or grow into the adjacent organs were removed. Five out of 54 patients died at different periods from the beginning of treatment. The remaining patients are under follow-up observation for periods ranging from 3 to 8 years. The overwhelming majority of patients resumed their normal avocations. (auth)

28794 THE RESULTS OF RADIOPHOSPHORUS THERAPY OF PATIENTS SUFFERING FROM ERYTHREMIA. F. A. Mazov and A. I. Lukina. Med. Radiol., 7, No. 6, 42-4 (June 1962). (In Russian)

Results are reported for 22 patients with polycythemia treated with radiophosphorus which was introduced with a 10% glucose solution, 1.5 to 2 mc per ingestion, the course comprising 6 to 8 mc. In 14 patients radiophosphorus therapy was combined with 2- to 3-fold bloodlettings (400 to 500 ml of blood each time). In all 22 patients favorable results were achieved. The effect occurred earlier if radiophosphorus therapy was coupled with preliminary bloodlettings. The authors observed that during radiophosphorus therapy the blood prothrombin indices and clotting time reverted to normal values. (auth)

28795 STUDIES ON THE EFFECT OF ^{60}Co GAMMA IRRADIATION ON THE GOAT. I. CHANGES IN BLOOD CONSTITUENTS FOLLOWING 1,000 r TOTAL BODY GAMMA IRRADIATION. Mitsuaki Hayashi and Noboru Miyao. Natl. Inst. Animal Health Quart. (Tokyo), 1: 215-24(1961). (In English)

Goats were irradiated with a dose of 1,000 r of Co^{60} γ-rays. Changes in blood constituents before and after exposure were compared between these goats, and non-irradiated controls, both of which were forced to fast during the same period. All irradiated goats died in about 10 days after irradiation. Loss in body weight was of the same extent in irradiated goats as in controls. Leukocyte counts remained unchanged for a short time after exposure, began to decrease sharply on the next day, and were reduced below 1,000 cells per mm^3 around the 3rd day postirradiation. Erythrocyte counts were not decreased, but increased immediately following exposure and, in some irradiated goats, also terminally. The blood sugar showed a tendency to increase in the irradiated group but decreased slightly in the control. The plasma protein exhibited a slight decrease around the first or second day postirradiation. Plasma nonprotein nitrogen showed a tendency to decrease. The amino nitrogen level in the plasma was scarcely changed. Plasma inorganic phosphorus appeared to increase in the fasting irradiated group. After exposure, the lipid phosphorus decreased markedly until the terminal period, when it increased slightly. This finding in the goat was quite different from that in other animals. Ribonucleic acid phosphorus, desoxyribonucleic acid phosphorus, and phosphoprotein phosphorus decreased from a comparatively early period after exposure. (auth)

28796 HISTOPATHOLOGICAL STUDIES ON THE EFFECT OF IRRADIATION WITH VARIOUS DOSES OF X-RAYS UPON THE HEMOPOIETIC TISSUE OF YOUNG MICE. II. CHANGES IN BONE MARROW. Isamu Takahashi, Kaoru Sakaki, Kiyoshi Hirasawa, and Kyoichi Tanaka. Natl. Inst. Animal Health Quart. (Tokyo), 1: 225-34(1961). (In English)

Histopathological observations were carried out on changes of the bone marrow of young mice irradiated with from 60 r to 600 r of x rays. Clear-cut damage was inflicted on the bone marrow even by irradiation with 60 r. Immature cells of the granulocyte series and some of the erythroblasts present were damaged by exposure to this dose of x rays. It was elucidated that the larger a dose of irradiation, the higher the severity of damage of the irradiated tissue. Damage was not only restricted to erythroblasts and immature cells of the granulocyte series, but also extended gradually to mature cells of the granulocyte series and megakaryocytes. Eventually, the bone marrow fell into a perfect state of aplasia after exposure to irradiation with 600 r. In every exposed animal, regardless of the dose of irradiation, the progression of damage was very rapid and accompanied by hyperemia and hemorrhage. The damage reached its maximum about 24 to 48 hours after irradiation. In general, the bone marrow underwent relatively rapid regeneration, in spite of their pronounced damage as mentioned above, and was restored to a normal state comparatively early. There were considerably great differences, however, in the progression of regeneration among the doses of x rays employed for irradiation, or among the degrees of severity of damage produced by irradiation. Erythroblasts were accompanied by pyknotic cells not infrequently in the early stage of regeneration after irradiation with a dose of 300 r or more of x rays. It showed unsatisfactory regeneration for a considerably long time in the succeeding period of restoration. Cells of the granulocyte series, however, proliferated relatively, showing a tendency to fall in hyperplasia. From these results, it is assumed that the erythroblasts may suffer severer damage than the cells of the granulocyte series when irradiated with a dose of 300 r or more. (auth)

28797 HISTOPATHOLOGICAL STUDIES ON THE EFFECT OF IRRADIATION WITH VARIOUS DOSES OF X-RAYS UPON THE HEMOPOIETIC TISSUE OF YOUNG MICE. III. CHANGES IN EXTRAMEDULLARY HEMOPOIETIC TISSUE OF SPLEEN AND SOME CONSIDERATION ON THEIR SIGNIFICANCE. Isamu Takahashi. Natl. Inst. Animal Health Quart. (Tokyo), 2: 48-58(1962). (In English)

Histopathological observation was carried out on the changes of the extramedullary hemopoietic tissue of spleen of young mice which had been irradiated with from 60 to 600 r of x rays. In addition to the observation, discussion was made on correlation between these changes and those in the bone marrow and on such correlation in connection with changes in the peripheral blood. Histopathological pictures of damage produced by various dose levels of x rays in the extramedullary hemopoietic tissue of the spleen were not so greatly different from those in the bone marrow. Generally speaking, the extramedullary hemopoietic tissue of the spleen began to be regenerated almost at the same time as the bone marrow. After that, however, it revealed more rapid proliferation than the bone marrow. Therefore, it fell into a state of hyperplasia prior to the recovery of the bone marrow. The larger the dose of irradiation applied, the longer this hyperplastic state lasted. Eventually the splenic hemopoietic tissue was restored nearly to normal conditions at the same time with the bone marrow. Such a difference as this between the two types of tissue during the phase of regeneration was displayed most remarkably in erythroblasts. This tendency was distinct especially after exposure to a dose of x rays not less than 300 r. From the findings on the hemopoietic tissue and peripheral blood, it is presumed that the extramedullary hemopoietic tissue of the spleen compensated the dysfunction of the bone marrow and played an important role in the recovery or prevention of decrease in number of peripheral erythrocytes and the recovery in the early period of granulocytes when animals exposed to x rays were at the stage of recovery from radiation injury. From these results, it is assumed that the extramedullary hemopoietic tissue of the spleen of the young mouse retains a hemopoietic function to some extent even under normal conditions. (auth)

28798 ACTION OF IONIZING RADIATION ON RAT LIVER CELL NUCLEI. G. Scholes, J. J. Weiss, and C. M. Wheeler (Kings Coll., Newcastle-upon-Tyne, Eng.). Nature, 195: 802(Aug. 25, 1962).

The effects of gamma radiation on suspensions of rat liver nuclei in phosphate buffer and in the presence of C^{14}-labeled sodium bicarbonate were studied. Of the total extent of carboxylation, only 3 to 4% go into the DNA fraction, by far the major reaction occurs in the protein and lipids. The composition (per cent) of the nuclei was approximately protein 85, DNA 10, RNA 2, and lipid 3. Even though the lipid fraction makes up only about 3% of the bulk of the nuclei, it accounts for 30% of the total incorporation. If it is assumed that the different proteins present in the cell nuclei have undergone about the same degree of carboxylation, it would follow that in the protein, which is possibly more specifically associated with the DNA, about 7% of the incorporation has occurred, that is, the relative extent of carboxylation of the DNA and of the protein in the complex is in the ratio 1:2. (P.C.H.)

28799 X-IRRADIATION OF ESCHERICHIA COLI. H. Laser (Cambridge Univ., Eng.). Nature, 195: 913-15 (Sept. 1, 1962).

An investigation was made on the effects of changes in temperature and growth rate on the post-irradiation viabil-

ity in E. coli. Two x-ray doses (4 and 8 kr) were given, the irradiated cells were incubated at 37 or 15°C, and colony counts were made after 1 or 5 to 6 days, respectively. The temperature did not significantly affect the number of non-irradiated controls, and only a small difference was found in the case of irradiated cells. The appearance of the colonies, however, differed greatly, and it was discovered that E. coli comprises two types of cells, filamentous forms forming petite colonies and single cells forming large colonies. The filamentous forms were found to be more radiosensitive than single cells and to have a smaller O_2 enhancement ratio. Cultures were grown from single colonies of both types to see whether the characteristics of the cells were maintained on growth at different temperatures; a clear separation of the cell types resulted. It is concluded that the formation of filaments in E. coli under unfavorable conditions complicates interpretation of irradiation effects. (D.L.C.)

28800 THE GENETICALLY SIGNIFICANT DOSE BY THE X-RAY DIAGNOSTIC EXAMINATIONS IN JAPAN. Nippon Acta Radiol., 21: 565-616(Sept. 25, 1961). (In English)

The genetically significant dose of 38.6 ± 4.2 mrem from x-ray diagnostic examinations was obtained in a survey in Japan in 1960. This value did not include the contribution from foetal exposure and other minor contributions such as dental and mass miniature exposure. The standard deviation is large because of the large variance in the gonad dose. (auth)

28801 PHYSIOLOGICAL EFFECTS OF GIBBERELLIC ACID. IV. ON BARLEY GRAIN WITH NORMAL, X-IRRADIATED, AND EXCISED EMBRYOS. L. G. Paleg, D. H. B. Sparrow, and A. Jennings (Univ. of Adelaide). Plant Physiol., 37: 579-83(Sept. 1962).

Measurements were made of the amylolytic activity, reducing sugar, and soluble nitrogen contents of barley grain with or without normal or x-irradiated embryos. The results indicate that the embryo is responsible for the initiation of the mobilization processes which occur in the endosperm during germination. X irradiation delays this initiation and complete removal of the embryo indefinitely postpones it. Gibberellic acid can hasten the responses of endosperm in the presence of normal or damaged embryos and can initiate them when the embryo is absent. A concentration above 2.9×10^{-6} M gibberellic acid was needed to produce an effect in the presence of the embryo, suggesting that this level may be close to the amount of endogenously produced gibberellin. (auth)

28802 ADRENAL CORTICAL HORMONE AND INCORPORATION OF RADIOACTIVITY INTO NUCLEIC ACID OF ISOLATED RAT DIAPHRAGM. Lloyd A. Ferguson and Ira G. Wool (Univ. of Chicago). Proc. Soc. Exptl. Biol. Med., 110: 529-32(July 1962).

Adrenalectomy stimulated incorporation of radioactivity from adenine-8-C^{14} into total nucleic acid and the RNA of isolated rat diaphragm. Moreover, adrenalectomy increased the actual amount of nucleic acid and of RNA that could be extracted from rat diaphragm. Cortisone administration (2 mg/day) was without effect on incorporation of C^{14} from adenine into nucleic acid or RNA, nor did it influence their amount. (auth)

28803 CORRECTION OF RADIATION-INDUCED THROMBOCYTOPENIA AND BLEEDING TENDENCY BY PRESERVED PLATELETS. Giovanni Raccuglia and Chris J. D. Zarafonetis (Univ. of Michigan, Ann Arbor). Proc. Soc. Exptl. Biol. Med., 110: 641-7(July 1962).

Rat platelets suspended in a glucose-sodium citrate-citric acid solution plus plasma have been introduced in polyethylene tubing of 0.125 inch in diameter and rapidly frozen by immersion of the whole container in liquid nitrogen. The material was stored in the same environment. The material was thawed by immersing the whole container in water at 45°C. Administration of these platelets to thrombocytopenic animals was associated with average increase of platelet counts from 36,900 to 205,793 in one hour. Eighteen hours after administration, 63.9% of these platelets were detectable in the circulation. Satisfactory correction of the bleeding tendency was observed in 66.6% of the recipients. (auth)

28804 RELATIVE EFFECTIVENESS OF DIRECT AND INDIRECT EFFECTS OF IONIZING RADIATION OF DESOXYRIBONUCLEIC ACID. M. I. Mekshenko (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 181-8(1962). (In Russian)

Direct and indirect x-radiation effects on 0.007 to 100% concentrations of DNA were analyzed. It was found that the ratio of direct-indirect effects (β/α) on the investigated DNA preparations exceeds one. The effectiveness (β/α) depends greatly on the quality of the preparation; the effect is enhanced by increased viscosity (polymeric strength). With reduced concentration the relative effectiveness (β/α) decreased while the direct effectiveness (β/β_0) showed a significant increase. A formula was developed for evaluating the direct and indirect effects as functions of solution concentration. (R.V.J.)

28805 OXIDATIVE PHOSPHORYLATION AND CONVERSIONS OF PYRUVIC ACID IN FRESH-ISOLATED BRAIN MITOCHONDRIA IN NORMAL AND IRRADIATED ANIMALS. R. I. Skvortsova (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 189-93(1962). (In Russian)

The oxidation phosphorylation process in isolated cerebral mitochondria was studied with normal and irradiated animals. On the second day following cerebellum exposure to 9 kr of radiation the oxidation phosphorylation is decreased. The optical density of mitochondria was 50% of that from control animals, indicating induced changes in mitochondria structure as a result of local exposure. During oxidation phosphorylation cerebellum mitrochondria lose about 90% of administered pyrotartaric acid, while with cerebellum irradiation only 29% is lost. (R.V.J.)

28806 ON CHOLESTERINE METABOLISM IN DOGS DURING RADIATION SYNDROME. K. V. Smirnov and V. A. Shaternikov. Radiobiologiya, 2: 194-5(1962). (In Russian)

Cholesterol metabolism in liver and intestine was studied in dogs exposed to 300 r of γ radiation at 450 to 460 r/min. The experiments failed to show any perceptible change in cholesterol synthesis. (R.V.J.)

28807 INFLUENCE OF ADRENALINE OXIDATION PRODUCT ON RADIATION INDUCED LEUCOPOENIA. R. N. Abdullina (Bashkirian Medical Inst., Ufa, USSR). Radiobiologiya, 2: 196-9(1962). (In Russian)

Adrenaline oxidation products administered prior to irradiation stimulated leukopoiesis in rabbits exposed to massive doses of γ radiation. Survival among treated rabbits was higher than among control animals. (R.V.J.)

28808 COMPARATIVE STUDIES OF X RADIATION AT 197 kv AND BREMSSTRAHLUNG FROM A 3-Mev LINEAR ACCELERATOR. A. K. Arnautov, Sh. A. Burshtein, V. S. Genes, et al. (Khar'kov Inst. of Physics and Tech.). Radiobiologiya, 2: 211-15(1962). (In Russian)

The indices of organism function in rats irradiated with 300 r and 600 r of x radiation and with bremsstrahlung from linear accelerator were correlated and the results tabulated. The condition of rats exposed to 300 r from

either source showed no initial visible differences. However, after 10 to 12 days, female rats irradiated with accelerator bremsstrahlung exhibited burns on the back and middle of the body, and after 30 days 4 out of 15 rats perished. None of the x-irradiated rats died. Effects of exposure to 300 r from a linear accelerator supplied with 1- and 2-mm tantalum films were identical to the effects of x radiation. Exposure to 600 r from a linear accelerator resulted in burns and subsequent death of 6 out of 14 animals, while no burns were visible in animals exposed to x radiation and only 3 out of 12 died. However, animals exposed to x rays died 12 to 14 days following the exposure, while animals exposed to accelerator irradiation died after 24 to 29 days. (R.V.J.)

28809 EFFECTS OF IONIZING RADIATION ON THE FUNCTION OF CILIATED EPITHELIUM IN FROG'S GULLET. L. D. Klimovskaya. Radiobiologiya, 2: 222-7(1962). (In Russian)

A total exposure to 50 kr of γ radiation disturbed the function of ciliated epithelium in frogs. The reaction to adrenalin depends on the background activity in the ciliated field. (R.V.J.)

28810 ON THE ROLE OF DISTURBANCES IN VEGETATIVE NERVOUS REGULATION IN IONIZING RADIATION INDUCED CHANGES IN CARDIO-VASCULAR SYSTEM. N. P. Smirnova. Radiobiologiya, 2: 228-33(1962). (In Russian)

A total exposure to x radiation induced disturbances of the central blood circulation apparatus. The disturbances were evaluated by the response of the hypothalamic region to irritation. An increased or changed reaction without variability in the excitation threshold are characteristic of hypothalamic effects of a neurohumoral nature (blood circulation and cutaneous vessel reaction). Considerable changes in irritation thresholds were found. (R.V.J.)

28811 INFLUENCE OF HYPOTHALAMUS AND RETICULAR FORMATION OF THE MID-BRAIN ON ELECTRICAL ACTIVITY IN DIFFERENT CORTICAL LAYERS DURING RADIATION SICKNESS. L. I. Kaburneyeva. Radiobiologiya, 2: 234-9(1962). (In Russian)

Electric irritation of hypothalamus and reticular formation of the midbrain change the electric functions of different cortex layers. First responses are found in the 5th layer of the motor region and the 3rd and 4th layers in the visual region of the cortex. Following irradiation, electric irritation of hypothalamus produces normalizing effects on the cortex biopotential, while irritation of the reticular formation does not. (R.V.J.)

28812 BLOOD STREAM IN THE LIVER IN NORMAL AND IRRADIATED DOGS. V. P. Fedotov. Radiobiologiya, 2: 240-5(1962). (In Russian)

Blood circulation in healthy and irradiated dogs was studied by determining the rate of $Na_2HP^{32}O_4$ passage through the liver. The results showed that in healthy dogs the first portions of radioactive phosphorus pass within 5 to 10 sec (7.1 ± 0.3) and the total mass passes within 15 to 25 sec (19.5 ± 0.4), while in dogs suffering from acute radiation sickness, blood circulation in the liver either slows down or speeds up with considerable slowing down in the final stages. (R.V.J.)

28813 ON CHANGES IN RADIOSENSITIVITY OF NERVOUS TISSUE. P. F. Minaev and O. F. Logvinova (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 259-64 (1962). (In Russian)

A local irradiation with 10 and 20 r induced a typical disturbance of the cerebellum function in 124 guinea pigs and 84 dogs. The irradiated cerebellum tissue accumulated pyroracemic and lactic acids, while vitamin B content and oxygen consumption decrease. Regeneration of cerebellum functions normalizes the metabolic processes. Protective narcotics introduced before exposure increase radioresistance in nervous tissues and depress radioinduced changes in metabolic processes. (R.V.J.)

28814 BEHAVIOR OF THE FRUIT FLY (DROSOPHILA MELANOGASTER) DURING IRRADIATION. V. G. Khrushchev, G. M. Pravdina, and N. G. Darenskaya. Radiobiologiya, 2: 272-9(1962). (In Russian)

A tendency to reduced oviposit was observed in female Drosophila melanogaster irradiated by P^{32} β rays. The sensitivity threshold did not exceed 0.02 r/sec. (R.V.J.)

28815 A STUDY OF AORTA REFLEX ARC DURING DIFFERENT STAGES OF RADIATION SICKNESS. A. N. Balashova. Radiobiologiya, 2: 280-6(1962). (In Russian)

Irritation of rabbit aorta by increasing oxygen (up to 37%) induces depressed reflexes. Ionizing radiation alters the reaction to oxygen irritation in receptor and center zones. Disturbed center reactions are clearly expressed during the first 5 to 7 days following exposure, then they return to normal while the receptor zone remains disturbed for a month or more. (R.V.J.)

28816 CHANGES IN THE HIGHER NERVOUS ACTIVITY IN THE SECOND GENERATION OF DOGS THAT SURVIVED CHRONIC INTERNAL β-IRRADIATION OF Sr^{90}. V. A. Nazarov. Radiobiologiya, 2: 287-92(1962). (In Russian)

Results of an investigation of the higher nervous system in 5 mature dogs of the second generation born to chronically irradiated (28 days) ancestors showed that while chronic internal exposure to β rays exhibited no visible injuries in the animals themselves, it caused disturbances in the cerebral cortex of the progenies of the first and second generations. (R.V.J.)

28817 DOSE DEPENDENCE OF DOMINANT LETHAL MUTATION FREQUENCY IN SPERMATIDS OF DROSOPHILA IRRADIATED WITH FAST NEUTRONS. E. A. Abeleva and U. A. Lapkin (Inst. of Biological Physics, USSR). Radiobiologiya, 2: 293-7(1962). (In Russian)

The appearance of dominant lethal mutations in Drosophila sperma after fast neutron doses of 600 to 2400 r is directly proportional to the dose. The dose relation in spermatids exposed to γ radiation and fast neutrons for dominant and recessive lethal mutations is quite similar. The relative biological efficiency of neutrons is 3 times higher than for γ radiation in sperma, while in spermatids it is only 1.5 times higher. The sensitivity of sperma and spermatids to fast neutrons is very similar to that of spermatids. (R.V.J.)

28818 ON THE ROLE OF TIME FACTOR IN RADIOPROTECTIVE EFFECT OF LOCAL ASPHYXIA OF BONE MARROW. N. P. Lebkova and S. P. Yarmonenko. Radiobiologiya, 2: 304-7(1962). (In Russian)

The protective effects of local marrow asphyxia during post-irradiation were analyzed by applying rubber bands on the hips of mice and removing them at various intervals after exposure. (R.V.J.)

28819 LONG RANGE STUDY OF PATIENTS EXPOSED TO THYMUS X IRRADIATION. A. Corinaldesi, G. Danieli, and C. Rimondi (Università, Bologna). Radiobiol. radioterap. e fis. med., (3) 16: 407-14(1961). (In Italian)

Hematological and clinical researches were carried out on 70 patients irradiated in childhood on the thymic region following thymic hypertrophy and Pende's syndrome, in order to ascertain, eventually, a higher incidence of leukemia or thyroid neoplasms. None of the patients seen showed hematological aspects for leukemia, pre-leukemia, or thyroid cancer. (auth)

28820 POSSIBILITY OF CHEMICAL RADIOPROTECTION IN PROLONGED EXPOSURE TO IONIZING RADIATION. M. Caprotti and L. Babini (Università, Pavia). Radiobiol. radioterap. e fis. med., (3) 16: 465-70(1961). (In Italian)

The radio-protective action of cysteamine on the mytosis of the radicular apices cells of Vicia Faba Equina was tested. After single irradiation a radio-protective action higher than 20% was obtained. After fractionated irradiation a greater protective capacity was found with respect to relatively high doses, while with respect to small doses, owing to the low number of radio-induced anomalies, the radio-protective capacity cannot statistically be well documented. (auth)

28821 CONSIDERATIONS ON THE MITOTIC MODIFICATIONS INDUCED IN EHRLICH ASCITES CARCINOMA FROM AGING OF THE TUMOR AND FROM THE ACTION OF IONIZING RADIATION. M. Caprotti and G. Straneo (Università, Pavia). Radiobiol. radioterap. e fis. med., (3) 16: 481-9(1961). (In Italian)

The frequency and the characteristics of single mitotic phases of Ehrlich ascites carcinoma in animals both under observation and subjected to radiation were studied. After irradiation an increase in prophase, a decrease of telophase, and a noticeable increase in the frequency of anomalies were noted. There were no significant variations in the frequency of polyploidal forms which instead increase with age. (auth)

28822 RADIATION THERAPY THROUGH COOLED SKIN. Marion F. Magalotti, Irvin F. Hummon, Rafael M. Garces, and N. S. R. Naumoff (Cook County Hospital, Chicago). Radiology, 79: 435-8(Sept. 1962).

Patients undergoing radiotherapy felt less discomfort, experienced less radiodermatitis, the skin healed faster, and there were fewer late changes in skin when the skin at the port of entry was cooled. Results are summarized for 100 consecutive women with pelvic tumors, all treated through 4 ports. (C.H.)

28823 EFFECT OF ANOXIA ON GUINEA PIGS SUBJECTED TO A SEMILETHAL DOSE OF ROENTGEN RADIATIONS. I. STUDY ON SURVIVAL, BODY WEIGHT, WEIGHT VARIATIONS, AND HISTOLOGICAL CHANGES OF SOME ORGANS. U. Meldolesi, G. Mazzella, and G. Paolucci. Riv. med. aeronaut. e spaziale, 24: 407-23 (July-Sept. 1961). (In Italian)

Anoxic guinea pigs were exposed to a dose of 360 x rays, corresponding to $LD_{30/30}$ days for the strain used. Observations were made of survival, variations in body weight, and histological changes in the liver, spleen, and testes. Anoxia failed to provide effective radiation protection demonstrable by the method used. Experiments of the same nature recently made on guinea pigs using different research methods showed even more clearly that anoxia does not protect guinea pigs from radiation damage. (auth)

28824 PHYSICAL AND TECHNICAL BASES OF SUPERVOLT-THERAPY. Erich Walter. Röntgen Bl., 15: 129-38(May 1962). (In German)

The differences as well as the progressive development caused by an increase of the radiation energy and the transition from photons to electrons are presented in several diagrams from a physical-technical viewpoint. The entire complex of contemplations is based on the controllability of the distribution of dose as the main principle. The question regarding any possible differences in the basic biophysical effect is also studied with the aid of simple diagrams. Finally, a description is offered of new technical designs of suitable radiation generators. (auth)

28825 THE INFLUENCE OF WHOLE-BODY RADIATION ON RENAL HEMODYNAMICS IN ACUTE EXPERIMENTS. A. Heidland, H. Braun, K. Kluetsch, and K. Ammon (Medical Univ.-Klinik, Wuerzburg, Ger.). Z. ges. exptl. Med., 134: 242-8(May. 1961).

Renal function and electrolyte excretion was studied 1 to 3.5 hr after irradiation of dogs with 200 to 800 r. In 6 out of the 9 dogs tested, no change occurred in effective renal plasma flow and glomerular filtration, which confirms the relative resistance of the kidney to the early effects of radiation. However, in 3 animals, clearance of exogenous creatinine and p-aminohippurate decreased. In these 3 animals, the drop in filtration following irradiation may have resulted from bleeding caused by heparinization of the dogs. Changes in renal hemodynamics showed no relation to the radiation dose; the 3 animals showing a drop in glomerular filtration received 200, 200, and 800 r. Although diuresis remained constant, excretion of Na dropped after irradiation, so that tubular reabsorption of Na did not appear to be impaired by irradiation. K excretion showed only slight, insignificant changes. (H.H.D.)

28826 A SIMPLE METHOD FOR APPLICATION OF RADIOACTIVE ISOTOPES IN THE HYPOTHALAMUS REGION OF THE GUINEA PIG. E. Fleischmann (Univ. of Vienna). Z. ges. exptl. Med., 134: 574-8(Aug. 1961).

Gold seeds (0.8 × 2.5 mm) were implanted in the hypothalamus by injection through the ear. The 5-day mortality of animals implanted with inactive Au was ~20% compared with ~50% for Au^{199}. However, 10 to 30% of animals implanted with 5 to 10 mc doses of Au^{198} survived 50 to 100 days or longer, depending on the dose. (H.H.D.)

28827 ON THE MORPHOLOGY OF EXPERIMENTALLY INDUCED RADIONECROSIS IN THE HYPOTHALAMUS OF THE GUINEA PIG. J. Zeithofer, E. Fleischmann, and G. Herrmann (Univ. of Vienna). Z. ges. exptl. Med., 135: 444-53(Mar. 1962).

Radiogold (Au^{198}) seeds (0.8 × 2.5 mm) were implanted in the hypothalamus of adult guinea pigs and the brains were examined histologically 30 min to 102 days later. The seeds varied in activity from 3 to 10 mc and controls were implanted with inactive gold. Implantation of seeds produced only slight bleeding at early stages and minimum scar tissue formation at late stages. However, after 1 to 2 days the active seeds induced marked hyperemia and edema in surrounding brain tissue, which was followed by leukocytic infiltration. Necrotic changes could be noted with 40 hr and by 4 to 6 days extended up to 1 mm beyond the implantation site. Ganglion and glial cells (especially macroglia) showed degenerative changes, and these changes depended in intensity on the radiation dose, calculated to to vary between 7,000 and 150,000 r. Edematous changes occurred in hypothalamus with 7,000 to 20,000 r and necrosis at doses above 30,000 r. At about the 14th day cyst formation began around the necrotic zone. Necrosis was considered to be a direct result of radiation on neural parenchyma, in spite of the known relatively high radioresistance of the central nervous system. (H.H.D.)

28828 THE USE OF INTERCHANGES INVOLVING B-TYPE CHROMOSOMES IN STUDYING ARTIFICIAL MUTAGENESIS IN MAIZE. G. Bellini, A. Bianchi, and E. Ottaviano (Univ. of Milan). Z. Vererbungslehre, 92: 85-99(1961). (In English)

Seeds of maize inbred lines A158, A158T, WF9, and WF9T (T = Texas factor for male sterility), whose water content ranged from 12 to 7%, were x rayed with 1, 2, 3, 4, 8, or 16 kr. Plants grown from the seeds were crossed

with TB-A stocks, possessing chromosomal interchanges between A and B chromosomes. These, because of non-disjunction of their B^A chromosomes in the microspore second mitosis, lead in F_1 ears to the production of hypoploid endosperm and embryo, in high percentage. Consequently, any mutation which has occurred in the corresponding segment of a normal or treated chromosome, being hemizygous, will be expressed on the F_1 ears or seedlings. The A chromatin segments involved in the B^A chromosomes were estimated to possess from about 100 genes to more than 600, according their size. About 4000 control and 10000 ears from treated material were examined in 1959 and 1960 crops. While the number of ears showing poor seed setting or lethal factors was correlated with the r doses only in 1960 crop, the chromosomal aberrations turned out always clearly increasing with the r doses. Consequently the mutagenic efficiency of the treatments is unquestionable, not to consider obvious physiological response, as germination and survival, clearly and proportionately affected by radiation, at least in 1960 with heavier treatments. On the contrary endosperm and seedlings mutations were not significantly increased by any treatment. These results confirm the chromosomal nature of the greatest majority of artificially induced mutations in maize, obtainable under the so far selected experimental conditions. The detectable rate mutation, both spontaneous and x-rays induced, does not seem to be correlated to the size of the chromatin segments analyzed. This also appears difficult to correlate with a genic interpretation of mutation in maize. (auth)

28829 ROL' PEREKISEI I KISLORODA V NACHAL-INYKH STADIYAKH RADIOBIOLOGICHESKOGO EFFEKTA. (Effects of Peroxides and Oxygen in Initial Stages of Biological Effects). A. M. Kuzin, ed. Moscow, Publishing House of the Academy of Sciences, 1960. 157p.

Eighteen articles are included on the effects of peroxides and oxygen in the initial stages of radiobiological effects. The papers were originally presented at the Conference of the Inst. of Biophysics, Academy of Sciences, USSR, Dec. 25-30, 1958. (R.V.J.)

28830 HOW TO DESIGN AND BUILD ABNORMAL BRAINS USING RADIATION DURING DEVELOPMENT. Samuel P. Hicks and Constance Joan D'Amato (Harvard Medical School, Boston and New England Deaconess Hospital, Boston). p.1-34 of "Disorders of the Developing Nervous System." William S. Fields and Murdina M. Desmond, comps. and eds. Springfield, Ill., Charles C. Thomas. 1961.

The patterns of abnormal development are presented that are caused by exposure of rat fetuses and embryos to doses of 150 to 200 r x radiation. Emphasis is placed on the mechanisms of malformations of the brain, the nervous system, and the retina. By removing some embryos or fetuses surgically at intervals during gestation beginning 3 or 4 hrs after radiation the several stages of the developing malformative patterns were studied grossly and microscopically in one litter. Some young were allowed to be born and grow up and studies were made on the whole sequence of developmental events and on anatomic findings and behavior in adults. Findings are described in detail. (C.H.)

28831 METABOLIC AND HISTOCHEMICAL STUDIES ON DIRECT RADIATION-INDUCED NERVE CELL NECROSIS. W. Zeman (Indiana Univ., Bloomington) and H. J. Curtis. p.141-7 of "IV. International Congress of Neuropathology. Vom 4.-8, September 1961. München. Proceedings in Drei Bänden, Thema I/Vol. I." H. Jacob, ed. Stuttgart, Georg Thieme Verlag, 1962. (BNL-5552) (In English)

Uncomplicated acute direct radiogenic cell death in nervous tissue, irradiated with microbeams, appears to be an autolytic phenomenon conceivably resulting from membrane breakdown due to a radiogenic cessation of protein synthesis. While the destruction of nerve cells is necessarily permanent, interstitial elements within the microbeam lesions are readily replaced by mitotic division of neighboring unirradiated cells. This repair is apparently so efficient, that no vascular disturbances can be detected with the light microscope. (auth)

28832 RADIATSIONNAYA GENETIKA SBORNIK RABOT. (Radiation Genetics Symposium). V. A. Engel'gardt, ed. Moscow, Publishing House of the Academy of Sciences, 1962. 367p.

Twenty-five articles on biological effects of radiation are included. The articles represent expansions of papers presented at the 8th conference of the Committee of Atomic Radiation in Geneva, 1960. The subjects include cytogenetic studies of radiation effects in animals, especially in monkeys; radiosensitivity of various animals; and effects of various doses on the sexual cycle, fertility, and functions of gonad systems. The effects of incorporated radioactive carbon in animals are analyzed and the initial cell damage is evaluated. (R.V.J.)

28833 HOMO- AND HETEROTRANSPLANTATION OF HEMATOPOIETIC CELLS. H. Braunsteiner (Universitatsklinik, Vienna). p.255-58 of "The Physiology and Pathology of Leukocytes." New York and London, Grune and Stratton, 1962.

The transfer of homologous and heterologous hematopoietic tissue is successful only when the recipient animal has received a lethal dose of irradiation. With sublethal doses transplanted cells are destroyed by the recipient animal whose immunological defense mechanisms have remained intact. The number of hematopoietic tissue cells that would ensure protection to humans after a lethal dose of irradiation was calculated to be 4×10^{10} cells, or the equivalent of the content of 2 to 4 ribs. Applications of lethal doses of irradiation followed by transfusion of new hematopoietic cells have not proved successful in the treatment of leukemia and hereditary anemia. (C.H.)

Radiation Sickness

28834 (NP-11982) INVESTIGATIONS ON THE PROBLEM OF FORMATION AND PATHOPHYSIOLOGICAL SIGNIFICANCE OF BIOGENIC AMINES IN SUBLETHAL RADIATION INJURIES. Quarterly Technical Status Report No. 3, May 1–July 31, 1962. Fr. Franzen (Cologne. Universitat. Medizinische Klinik). July 31, 1962. Contract DA-91-591-EUC-1978. 3p.

Fluorescence spectrophotometric determinations of 7 biogenic amines (dopamine, 1-noradrenaline, adrenaline, tryptamine, 5-hydroxytryptamine, bufotenine, and histamine) were carried out in the urine of rats treated with whole-body irradiation. The rats received subcutaneously from the first day post irradiation phenylacetic acid (6 single doses) or alpha-methyl-dopa (3 single doses) dissolved in sterofundin. Phenylacetic acid reduced the radioinduced overexcretion of noradrenaline and adrenaline only moderately but reduced tryptamine, 5-hydroxytryptamine, and bufotenine nearly completely, and that of dopamine and histamine totally. Alpha-methyl-dopa reduced the radioinduced overexcretion of tryptamine, 5-hydroxytryptamine, bufotenine, and histamine about 50% from the first day after irradiation. (P.C.H.)

28835 (JPRS-15002) CONCLUSION FROM: LESIONS OF THE SKULL AND BRAIN IN ACUTE RADIATION SICKNESS. V. N. Shamov, ed. Translation of p.119-34 of "Raneniya Cherepa i Golovnogo Mozga pri Ostroi Luchevoi Bolezni" Leningrad, 1962. 15p.

The results of experiments on 814 rabbits injured by penetrating radiation indicate that wounds of the skull and brain become particularly severe and aggravate the course of acute radiation sickness. Since infectious complications, pneumonia, and other infectious processes frequently develop due to the combined radiation sickness and injuries, careful surgical treatment of the wound, as well as early and systematic use of antibiotics, must be administered. For preventing infectious complications, the administration of mixtures of penicillin and streptomycin or large doses of penicillin seem most effective. The antibiotics are administered by intramuscular injections and application to the wound itself, or injection into the subarachnoid space. Contaminated and infected wounds of the skull and brain which are treated and sutured within three days after injury heal by primary intention in the majority of cases. (N.W.R.)

28836 THE EFFECT OF RADIOPROTECTIVE AGENTS ON TISSUE NONPROTEIN SULFHYDRYL AND DISULFIDE LEVELS. Bo Soerbo (Medical Nobel Inst., Stockholm and Research Inst. of National Defense, Sundbyberg, Sweden). Arch. Biochem. Biophys., 98: 342-4(Aug. 1962).

Reaction mechanisms involved in the radioprotective effects of aminoethylthiosulfuric acid and aminoethylthiophosphate in mice were investigated. The thioesters were injected into irradiated and control mice and the nonprotien sulfhydryl and disulfide content of spleen, liver, and blood were determined. Results were compared with those using other protective and nonprotective compounds. Results indicate that aminoethylthiosulfuric acid and aminoethylthiophosphate are converted in vivo to cysteamine, which then may be the effective protective agent. (C.H.)

28837 STUDY ON THE ETIOLOGY OF CONGENITAL ABNORMALITIES, ESPECIALLY MATERNAL ENVIRONMENTS. Akira Tabuchi, Atsushi Fujiwara, Michinori Ishibashi, and Kazuo Kinutani (Hiroshima Univ. School of Medicine). Hiroshima J. Med. Sci., 10: 53-60(Dec. 1961).

The possible influence of environmental and hereditary factors (atomic bomb exposure, radiation from other sources, socioeconomic status, consanguineous marriage, etc.) was studied in 32 children with congenital anomalies born in Hiroshima prefecture from January 1959 to December 1960, out of a total of 4566 births (0.7%). Among this total were 126 stillbirths and neonatal deaths, in 11 of which deformities were present. Of the surving children with deformities, anomalies of the skeletal and central nervous systems were most prevalent. From the results of questionnaires and other analyses it was concluded that exposure to the atomic bomb may have been of etiologic significance in 22% of the deformities of surviving children; 28% of their mothers were exposed. In a further study of 4529 older, physically and mentally handicapped children, atomic bomb exposure and radiation therapy were thought to contribute to 5 to 25% of the abnormalities (congenital dislocation of hip, cerebral paralysis, mental retardation, deafness and blindness). In a 3rd study of 47 women who were pregnant during exposure, abortion, stillbirth, or premature birth occurred in 5 cases and the 42 surviving children had deformities of the central nervous system. In a 4th study of 832 children born of 474 exposed Hiroshima women from January 1958 to December 1960, there were 2 cases of congenital deformities, 72 of prematurity, 27 stillbirths, and 28 neonatal deaths. A comparison of 366 children born in the same period of exposed parents with 500 of unexposed parents revealed prematurity rates of 10.7 and 7.4%, respectively. The frequency of prematurity among women exposed within 1 km of the epicenter during pregnancy was very high; each of the 3 cases cited gave birth to premature children. Although the role of radiation in producing congenital deformities could not be clearly discerned, it was considered that the rate of deformities in the 1st generation offspring of exposed atomic bomb survivors in Hiroshima is relatively low, and that other environmental and hereditary factors play a larger role. (H.H.D.)

28838 EFFECTS OF AMINO ACID PREPARATIONS, POTENTIATED ANESTHESIA, AND ARTIFICIAL HIBERNATION ON POST-IRRADIATION SIDE-EFFECTS. Ryoichi Uemura, Shigeru Iwamori, Masaru Hirata, Syoji Imai, Nobuo Nagata, Yukio Imada, and Yoshiya Horikawa (Hiroshima Univ. School of Medicine). Hiroshima J. Med. Sci., 10: 61-73(Dec. 1961).

The possible protective effect of various substances, injected 15 to 30 min before irradiation, was investigated in mice and rats. In mice given a single 500-r dose, the most effective protective combination was chlorpromazine and an amino acid mixture. This partially inhibited the drop in circulating leukocytes and decrease in body weight, and increased survival time. Less effective, singly and in combination with amino acids, were promethazine and meperidine, and least effective was a combination of the 3 drugs without amino acids. Similar results were obtained in mice exposed daily to 20-r whole-body doses and in irradiated rats bearing Ehrlich ascites carcinoma. Clinical studies were also carried out in which 35 cancer patients were given, before radiation therapy, an amino acid mixture and chlorpromazine. It was considered that side effects of irradiation in this group were reduced about 50%, including anorexia, headache, nausea, and pain. Also, decreases in circulating leukocytes, erythrocytes, and hemoglobin were less marked. (H.H.D.)

28839 LIVER DISEASE INCIDENCE AMONG ATOMIC BOMB SURVIVORS: A STATISTICAL STUDY. Kiyoshi Shimizu, Mineo Watanabe, and Sadato Ito (Univ. of Hiroshima). Hiroshima J. Med. Sci., 10: 103-4(Dec. 1961).

The survey was conducted in 1875 cases (595 men and 1280 women) from 1957 to 1960 applying for treatment of bomb sequelae in Hiroshima. Liver disease was found in 330 persons, 26.7% of the men and 13.4% of the women. The average age of the men with liver disease was higher (50 yr) than that of the women (45 yr). Of those affected with liver disease, 56.0% of the men and 55.0% of the women were within 2.1 km of the epicenter, whereas 33.3% and 31.6%, respectively, were beyond this distance. 10% of the men and 13% of the women entered the city shortly after the explosion. In this group of unexposed early entrants, liver disease was mild and without complications. The incidence of liver disease complications was lower in men (23.3%) than in women (42.1%), anemia being the most prevalent (in 19.0% of men and 36.8% of women), but this incidence did not appear to be related to distance from epicenter. The rate of exposure outdoors compared with indoors was considerably higher in the men than women. (H.H.D.)

28840 ACCELERATED BREAKDOWN OF IMMUNOLOGICAL TOLERANCE FOLLOWING WHOLE BODY IRRADIATION. O. Makela and G. J. V. Nossal (Stanford Univ., Palo Alto, Calif.). J. Immunol., 88: 612-20(May 1962).

The effects of sublethal doses of whole-body radiation

on immunologic tolerance were studied in rats made tolerant from birth to bovine serum albumin (BSA) or mouse erythrocytes. The unresponsiveness, though not always complete, remained constant in a given animal if antigen injections were continued. In animals irradiated with 550 or 660 r the tolerance usually broke down, with the formation of substantial amounts of antibody. Normal animals also irradiated at a similar age and given repeated injections of mouse erythrocytes formed excess antibody during the 5th to the 13th postirradiation week. By contrast, irradiated rats receiving a single injection of BSA in Freund's adjuvant formed less antibody than did nonirradiated controls. Two possible ways in which irradiation may abolish tolerance are propsed. If tolerance depends on the presence of antigen in immunologically competent cells, the rapid proliferation of cells during recovery from radiation damage may dilute the antigen below an inhibitory threshold. Alternatively, if tolerance is due to inactivation of certain antibody-forming cells, during the regeneration process new, immunologically competent cells may arise. (H.H.D.)

28841 HYPOTENSION AND VASOCONSTRICTION IN ACUTE RADIATION SICKNESS. K. B. Tikhonov. Med. Radiol., 7, No. 6, 58-68(June 1962). (In Russian)

Angiography was used in experiments on dogs to show the relation between the quantity of circulating blood, blood pressure, and size of the lumen of large blood vessels of the extremities and pelvis. Such a dependence exists in healthy and irradiated animals. A sharp constriction of vessels constantly observed during the peak of acute radiation sickness is due to the reduced volume of circulating blood. Vasoconstriction is viewed as a compensatory mechanism for maintaining an optimal level of the blood pressure in progressive hypotension as the result of reduced content of circulating blood. (auth)

28842 PROTECTIVE EFFECT OF NITROUS OXIDE AGAINST TOTAL-BODY RADIATION IN THE MOUSE. J. C. Evans and Louis R. Orkin (Yeshiva Univ., New York). Nature, 195: 822-3(Aug. 25, 1962).

Investigations on the protective effects of nitrous oxide in mixtures with oxygen as measured by lethality in mice from whole-body irradiation show that nitrous oxide does give significant protection at elevated pressures. An attempt was made to rule out the possibility that the protection was due to narcosis, with diminished tissue oxygenation, by subjecting groups of mice to a comparable level of anesthesia with pentobarbital during irradiation in air at 2 atm pressure. In air at 1 atm pressure there was protection from the lethal effect of whole-body irradiation. In air at 2 atm pressure, there not only was no protection in either CBA or C57 L strain mice, but actually a higher lethality in the group anesthetized with pentobarbital. It is concluded that nitrous oxide does diminish radiosensitivity in vivo, in the presence of adequate oxygen supply, if the gas mixture is at elevated pressure. (P.C.H.)

28843 QUANTITATIVE STUDY OF THE ERYTHROCYTES IN THE CASE OF SICKNESS AFTER RADIOTHERAPY. S. Pendić, Z. Merkas, M. Bekerus, and N. Nestorović ([Univ. of Belgrade]). Primena Radioaktiv. Izotopa i Jonizujucih Zracenju u Med., 2: No. 3, 36-44 (Dec. 1961). (In Yugoslavian)

$Na_2Cr^{51}O_4$ was used as a tracer in a quantitative study of the destruction and production of erythrocytes in radiation sickness induced by radiotherapy. Data from 18 cases are summarized. (C.H.)

28844 AET PROTECTION OF REPRODUCTIVE CAPACITY OF IRRADIATED MICE. Udo H. Ehling and David G. Doherty (Oak Ridge National Lab., Tenn.). Proc. Soc. Exptl. Biol. Med., 110: 493-4(July 1962).

Treatment of female mice with S,2-aminoethylisothiourea-DiHBr (AET) before 50 r whole-body x irradiation gave some protection to their reproductive capacity when compared to irradiated controls, increasing the length of the reproductive period, the number of litters per female and the number of offspring per female. (auth)

28845 EFFECTS OF A RADIOPROTECTIVE AGENT ON TISSUE SEROTONIN LEVELS IN THE X-IRRADIATED RAT. B. H. Ershoff, R. Hellmers, and A. F. Wells (Western Biological Labs., Culver City, Calif.). Proc. Soc. Exptl. Biol. Med., 110: 536-8(July 1962).

Young adult male rats exposed to a single dose of 450 r or 900 r total-body x irradiation exhibited a highly significant reduction 1, 3, and 6 days post x-irradiation in the serotonin concentration of the blood, spleen, brain, and small intestines. No significant reduction in tissue serotonin levels occurred in rats exposed to 900 r total-body x irradiation and administered 2-mercaptoethylguanidine intraperitoneally at a level of 200 mg per kg of body weight 20 minutes prior to x-irradiation exposure. (auth)

28846 ON THE MECHANISM OF PROTECTIVE ANTIOXIDATIVE ACTION OF SOME S-COMPOUNDS. A. I. Zhuravlev and B. N. Tarusov. Radiobiologiya, 2: 177-80 (1962). (In Russian)

It is shown that β-mercaptopropylamine, β-mercaptoethylamine, tiosulfate, and colloidal sulfur have active antioxydative prophylactic effects in radiation injuries. They delay the autooxidation of oleic acid and reduce over acidification. The antioxidation effects can be observed in increased chemoluminescence in the visible spectrum. (tr-auth)

28847 ACCELERATION OF THE ELIMINATION OF YTTRIUM, CERIUM AND LEAD FROM THE ORGANISM WITH URAMYLDIACETATE, 1,2-DIAMINECYCLOHEXANTETRACETATE AND POLYETHYLENPOLYAMINOPOLYACETATE. I. P. Tregubenko, I. V. Podgornaya, I. Ya. Postovskii, and D. I. Semenov (Biophysical Lab. and Sverdlovsk Inst. of Chemistry, Ural Branch of the Academy of Sciences, USSR). Radiobiologiya, 2: 200-6(1962). (In Russian)

An early administration of PEPAPA (polyethylenepolyaminopolyacetate) exhibits a significant effect on cerium and lead isotope deposition in tissues and on their elimination. The PEPAPA has an identical effect to UDA (uramildiacetate) and a greater effect than DCHTA (1,2-diaminocyclohexanetetraacetate). At later dates applications of PEPAPA speed up the elimination of Ce, Y, and Pb considerably more than the other two preparations. UDA promotes to some extent elimination of Ce, Y, and Pb isotopes at later dates, but elimination by late applications of DCHTA depends on the calcium elimination factor. (R.V.J.)

28848 DOSAGE EFFECTS IN DEATH OF EXPOSED MICE. L. B. Koznova. Radiobiologiya, 2: 216-21(1962). (In Russian)

Additional data are offered on the pathology of mice exposed to lethal doses of radiation at 0.019 to 147 r/sec. Lethal doses from 6,267 to 155,565 r were administered during periods of 3.8 days to 17 min 38 sec. Visual observations during continuous exposure at 3.6 to 147 r/sec until expiration revealed five stages of sickness. (R.V.J.)

28849 EFFECTS OF IONIZING RADIATIONS ON THE REACTIVITY OF ADRENERGETIC AND CHOLINERGETIC RECEPTORS. A. Danysh (Medical Academy, Belostok, Poland). Radiobiologiya, 2: 246-54(1962). (In Russian)

Experiments with 1113 mice, 115 guinea pigs, 44 cats, and 17 dogs irradiated with 180 to 200, 450, 400, and 400 r, respectively, showed that at the acute stages the excitation of adrenergic receptors in relation to catecholamine is increased and the activity of monoaminoxidase inhibitors decreases. The suprarenal adrenaline level also decreases. The response of cholinergic receptors to parasympathicotonic agents is reduced, especially in certain organs. Simultaneously the receptor sensitivity to blocking agents (atropine) increases followed by reduced cholinesterase activity. (R.V.J.)

28850 ON STATE OF THE CENTRAL PART OF UNCONDITIONED VASCULAR REFLEX ARC DURING RADIATION SYNDROME. G. V. Bavro. Radiobiologiya, 2: 265-71(1962). (In Russian)

It is postulated that hemodynamic disturbances caused an increased excitation in the vascomotor center in medulla oblongata and an alteration in response to direct electric irritation during acute radiation sickness. (R.V.J.)

28851 INCREASED RADIOPROTECTION AFTER COMBINED USAGE OF 5-METHOXYTRYPTAMINE AND MERCAMINE. I. G. Krasnikh, P. G. Zherebchenko, V. C. Murashova, N. N. Suvorov, and N. P. Sorokina. Radiobiologiya, 2: 298-303(1962). (In Russian)

Radioprotective effects of 5-methoxytryptamine with β-mercaptoethylamine or β-mercaptopropylamine or both were analyzed for various radiation doses. Applications of 5-methoxytryptamine with mercaptoamine are effective even for lethal doses (1000 r), while separate applications of these preparations do not prevent fatalities. Applications of β-methoxytryptamine and β-mercaptoethylamine reduced degenerative changes in the cells and the number of micronecrotic nidi in the marrow and spleen of mice and rats. Applications of all three preparations are much more effective in reducing degenerative and micronecrotic changes in the hematopoietic cells. (R.V.J.)

28852 REPARATION PROCESSES IN BONE MARROW OF IRRADIATED RATS AFTER TRANSPLANTATION OF ISOLOGOUS BONE MARROW. S. A. Rogacheva. Radiobiologiya, 2: 308-16(1962). (In Russian)

The most successful therapeutic effect was achieved by marrow injection 24-hr following exposure (83.3% 60-day survival against 11.2% in controls). Exposure to 1000 r produced a sharp reduction of marrow cells in all animals. Injected marrow stimulated faster restoration of bone cell composition during 4 to 7 days after exposure. The cytological picture of treated animals attest to the presence of two restorative mechanisms (repopulation of donor cells and stimulation of the hematopoietic system of the recipient). (R.V.J.)

28853 EFFECT OF RADIOPROTECTORS ON IRRADIATED E. COLI IN OXYGEN-DEPRIVED MEDIUM. E. A. Val'dshtein (Inst. of Cytology, Leningrad). Radiobiologiya, 2: 317-21(1962). (In Russian)

Under strictly anoxic conditions (in addition to nitrogen protection without cystamine) cystamines offer additional protection to E. coli B and B/r. Cystamine and $Na_2S_2O_4$ do not give additional protection (experiments with E. coli B) under identical conditions. The cysteamine protection is not limited to participation in the oxygen effect, but offers other protective mechanisms. Oxygen concentrations less than 0.003% produce no radiosensitizing effects on E. coli. (R.V.J.)

28854 ON THE POSSIBLE GENERAL MECHANISM OF THE ACTION OF CHEMICAL PROTECTORS. E. E. Ganassi and L. Kh. Eidus (Inst. of Biological Physics, Moscow). Radiobiologiya, 2: 332-4(1962). (In Russian)

The mechanism of macromolecular protection was investigated in 0.02 mg/ml concentrations of aqueous pepsin solutions (acidified with hydrochloric acid to pH 4.5 to 4.6) irradiated with Co^{60} γ rays. Damage was determined by proteolytic activity. Sodium nembutol, cystamine, sodium methabisulfite, AET, and β alanine were used as protective chemicals. Pepsin inactivation in the presence of cystamine is plotted as a function of various protector concentrations. A certain correlation was observed between the molecular dimensions of the protective materials and their blocking ability, the larger the molecule the smaller the concentration required to achieve a given degree of protection. (R.V.J.)

28855 GRANULOCYTES AND RADIATION INJURY. G. Brecher (National Institutes of Health, Education and Welfare, Bethesda, Md.), W. W. Smith, and E. P. Cronkite. p.220-31 of "The Physiology and Pathology of Leucocytes." New York and London, Grune and Stratton, 1962. (BNL-5265)

Results of studies on the radiosensitivity of the hematopoietic system show that the function of granulocytes is not limited to phagocytosis of bacteria. Granulocytes seem to be able to protect the body from fatal effects of disseminated infection following invasion by the normal flora of the intestine or of the external environment. This implies that granulocytes normally maintain the relative sterility of the organs and the blood stream. The role of granulocytes in the control of infections induced by radiation exposure is discussed. (C.H.)

CHEMISTRY

General and Miscellaneous

28856 BEHAVIOR OF l-ASCORBIC ACID AS SUPPORT ELECTROLYTE. INFLUENCE OF THE MAGNESIUM ION. J. Alonso-López (Junta de Energia Nuclear, Madrid). Anales real soc. espan. fís. y quím. (Madrid), Ser. B, 57: 733-40(Dec. 1961). (In Spanish)

The behavior of l-ascorbic acid as supporting electrolyte of the uranyl ion at 0.1 to 0.7 M concentration and the influence of pH on the diffusion current and half-wave potential of 0.1 M uranyl ion are studied. The cathodic waves from 0 to −2.5 v with mercury dropping electrode are studied in fresh 0.1 M aqueous solution in presence of Mg^{2+} and at 2.0 to 12 pH. A kinetic current with a half-wave potential of −0.85 v vs. Hg. d. e. is obtained at pH > 4. The same current had a second wave at −1.20 v in alkaline medium. At pH > 9.5 appears a third wave at −0.60 v. The pH variation does not influence these potentials. An inhibitor effect is produced by Mg^{2+} on the kinetic wave of dehydroascorbic acid, at a pH ~ 6.0, because of the magnesium ascorbate formation. This salt at 2.4×10^{-1} M extinguishes the kinetic current, by which the interference is eliminated and the field of analytical application is enlarged. The catalytic waves of hydrogen have no valuable alteration in the presence of Mg^{2+}. At pH < 8.0 maxima have not been found. (auth)

28857 PERMASELECTIVITY OF INORGANIC ION-EXCHANGE MEMBRANES MADE UP OF ZIRCONIUM PHOSPHATE SUPPORTED ON GLASS FIBERS. Giulio Alberti (Comitato Nazionale Energia Nucleare, Rome). Atti. accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 31: 427-8(Dec. 1961). (RT/CHI(62)9). (In Italian)

The preparation of zirconium phosphate ion-exchange membranes and preliminary results on the permaselectivity of these membranes for alkali metal ions are reported. (auth)

28858 THE CATALYTIC EFFECT OF SOME ORGANIC ACIDS ON THE OXIDATION OF URANIUM(IV) BY THALLIUM(III) IN PERCHLORIC ACID. Lawrence Paul Quinn (Michigan State Univ., East Lansing). Dissertation Abstr., 23: 63-4(July 1962).

The reaction between uranium (IV) and thallium (III) in the presence of various organic acids was studied. Dibasic saturated acids studied were oxalic acid, malonic acid, and succinic acid. Oxalic acid and succinic were found to inhibit the reaction. Oxalic acid has only a slight effect on the system compared to succinic acid. Malonic acid has no effect on the rate of the system. The unsaturated dibasic acids, fumaric acid and maleic acid, were investigated along with the hydroxy dibasic acids, malic and tartaric. Under the appropriate conditions these acids all catalyze the reaction. At low concentrations of fumaric or maleic acid, the reaction between uranium (IV) and thallium (III) is catalyzed, but as the concentration of the organic acid is increased, the effect is to inhibit the reaction. Tartaric acid appears to exhibit the same behavior, and although the evidence is scanty malic acid is believed to catalyze the reaction. Partial rate laws were determined. The reaction is first order in uranium (IV) and thallium (III), and in the accelerated area the order of the maleic acid is 0.07, while in the inhibited area the maleic acid has an order of −0.84. The hydrogen ion was found to have an order of −1.17 in the inhibited area. (auth)

28859 RADIATION DAMAGE IN ORGANIC CRYSTALS. III. LONG POLYENE RADICALS. M. W. Hanna, A. D. McLachlan, H. H. Dearman, and H. M. McConnell (California Inst. of Tech., Pasadena). J. Chem. Phys., 37: 361-7 (July 15, 1962).

The distribution of electronic spin in a series of linear odd-alternant polyene radicals is calculated using valence-bond, Hückel, and the "extended" Hartree-Fock methods. These theoretical results are compared with the spin distributions in a series of free radicals produced by irradiation of polyene acids, $CH_3(CH = CH)_{m-1}COOH$, m = 2 to 5, 7. The experimental spin distributions are deduced from the line shape of the ESR spectra of polycrystalline samples by making use of a method relating the second moments of the ESR spectra to the spin distribution. Experimental evidence is adduced for the presence of negative spin density on the "unstarred" atoms of these radicals. The relation between these results and the problem of bond alternation in long polyene radicals is discussed. (auth)

28860 STUDIES ON METALLIC ZIRCONIUM PRODUCTION FROM ZIRCON. PART 1. ALKALI FUSION OF ZIRCON ORE. Jae-sik Han and Jung-jae Maeng. Kwayon Hwibo, 5: 113-18(1960). (In Japanese)

Zircon samples, gathered from Yongsanpo, Korea, were separated through magnetic separator and pulverized by ball mill over 250 mesh. In the alkali fusion process, it is considered that zircon is decomposed not only into sodium zirconate but also into a comparatively large part of complex compound of zirconium and silicon in a sodium salt such as sodium silicozirconate. The latter resulted in the formation of gelatinous silica when fusion products are dissolved into mineral acid. The best conditions for decomposition of Korean zircon ores were particle sizes smaller than 250 mesh, mixed with double ratio of flake form caustic soda and fused at 650 ± 10°C for two hours. (auth)

28861 PURITY AND STABILITY OF COMMERCIAL SODIUM IODOHIPPURATE LABELLED WITH IODINE-131. Goesta Magnusson (Karolinska Institutet, Stockholm). Nature, 195: 591-2(Aug. 11, 1962).

Sodium iodohippurate labeled with I^{131} was analyzed by chromatography and electrophoresis. The stock solution (pH about 7.5) contained 1 mg sodium iodohippurate per ml and 500 μc I^{131} per mg; 0.9% benzyl alcohol and 2 mg sodium citrate per ml were added as preservative and stabilizing agents, respectively. In one-way chromotography Radio-Hippuran divided consistently into 2 distinct fractions, one large (A) and one small (B). In the electrophoresis two distinct components were also shown, which wandered towards the anode with different velocities, the bigger fraction (A-Ef) with about 2.1 mm/min and the smaller fraction (B-Ef) with about 6.3 mm/min. A small component (C-Ef) moved with a velocity of 0.9 mm/min, consisting of 0.5 to 0.7% of the total radioactivity. The relative content of radioactivity in the A-fractions agreed well with each other in the same stock solution and amounted to 95 to 80% of the total radioactivity, while the B-components contained most of the rest. The older the solution, the more radioactivity appeared in the B-fractions. The A-components were assumed to be I^{131}-labeled iodohippurate and the B-components, impurities or disintegration products of iodohippurate. (P.C.H.)

28862 REPORT OF THE COMMISSION ON ATOMIC WEIGHTS, 1961. p.281-322 of "Comptes Rendus De La

Vingt et Unieme Conference, XXI, Montreal 2-5 Aout 1961." London, Butterworths Scientific Publications, [1961]. (In English)

Tables of relative atomic weights and radioactive elements based on the atomic mass of $C^{12} = 12$ are given. The work that went in the decision to adopt the C^{12} mass scale is reviewed. Nuclidic masses and isotopic abundances are discussed. Chemical determinations involving Ag, Cl, and Br are reviewed in detail. Finally, each element is reviewed in turn. (D.L.C.)

Analytical Procedures

Refer also to abstract 30021.

28863 (AERE-R-3945) THE DETERMINATION OF ZINC-65 IN HARWELL EFFLUENT. B. A. Loveridge and A. F. Owens (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1962. 17p.

Zinc carrier is added to an aliquot of effluent. Radiolead is removed by coprecipitation with strontium sulfate before the zinc is extracted by dithizone supported on a column of cellulose acetate chips. The zinc is eluted with hydrochloric acid and after three scavenging precipitations to remove interfering nuclides it is recovered as zinc quinaldinate and gamma counted. Radio-zinc may be recovered from sea water by the same method. (auth)

28864 (EURAEC-269) APPLICATION OF TRANSITIONAL ELECTROCHEMICAL METHODS TO THE CHEMICAL ANALYSIS OF PRODUCTS INTENDED FOR NUCLEAR CHEMISTRY. Special Report No. 1. (Brussels. Université). Feb. 1962. Work performed under United States - Euratom Joint Research and Development Program. Contract 018-60-7RDB. 37p.

Activities in a program to study electrochemical prepolarization methods are reported in which the cases of ideally polarized and depolarized electrodes are considered separately. The adsorption of organic substances on ideally polarizable electrodes was studied by considering cases in which equilibrium is decreasing and by analyzing the E(t) curves in these cases. The case of depolarized electrodes was then examined with only one depolarizer in the solution. The advantages of the control and the use of the depolarization potential were brought out by showing in particular how it is possible to test and eliminate the effects of a previous parasitical discharge and the effects of electro-capillary agitation of the Hg surface resulting from the initial potential jump. A study was also made of the case in which the depolarizer itself is adsorbed, and a method was recommended which makes it possible to estimate the quantities adsorbed and to establish the adsorption isotherm. (auth)

28865 (IA-691) OXYGEN-18 ANALYSIS BY COUNTING DELAYED NEUTRONS OF NITROGEN-17. S. Amiel and M. Peisach (Israel. Atomic Energy Commission, Tel Aviv). June 1962. 22p.

Neutron counting of 4.14-sec N^{17} is used for the analysis of O^{18} in solutions containing known amounts of Li^6. N^{17} is produced by the successive nuclear reactions $Li^6(n,\alpha)t$; $O^{18}(t,n)N^{17}$ on irradiation with thermal neutrons. The total delayed neutron emission of a sample irradiated to saturation at a thermal neutron flux of 10^{13} n/cm^2-sec is about 4×10^5 neutrons per mg Li^6 per atom percent O^{18}. The N^{17} formation is proportional to the atom fraction of O^{18} and is independent of the sample size. (auth)

28866 (HW-SA-1972) ABSORPTIOMETRY WITH POLYCHROMATIC X-RAYS. Maurice C. Lambert (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1, 1960. Contract AT(45-1)-1350. 40p.

A description of the principles of absorptiometry with polychromatic x rays and a short historical account of the instrumentation development are given. The principal advantage of the use of polychromatic x rays is the very high intensity available from such a source. Absorption data are discussed as a function of the concentration of the element, the path length, the voltage on the x-ray tube, and the atomic number of the element under consideration. The anomalous absorption behavior of the middle weight elements is explained on the basis of their absorption edges. Empirical absorption coefficients are given for ions in beams. Examples of the calculation of interference errors, factors affecting precision, and several measurement techniques are also described. This discussion is intended to help to evaluate the application of x-ray photometry to any problem of interest in the field of chemical analysis. The method was of great value at Hanford for the rapid determination of uranium and of plutonium in a variety of process solutions and in certain alloys and reactor fuel elements. Typical applications of the method to the analysis of single and mixed solutes and to the analysis of metal alloys are described. (auth)

28867 (IEA-46) SEPARAÇÃO E DETERMINAÇÃO ESPECTROGRÁFICA DE TERRAS RARAS EM URÂNIO. (Separation and Spectrographic Determination of Rare Earths in Uranium). Alcídio Abrão (Brazil. Instituto de Energia Atomica, São Paulo). Nov. 1961. 17p.

Traces of rare earths elements, mainly those possessing high thermal neutron absorption cross sections: Gd, Dy, Er, Sm, and Eu, were determined spectrographically after chemical separation from uranium. Uranyl chloride in hydrochloric acid was extracted with TBP, the rare earths were coprecipitated with thorium ammonium fluoride, Th was removed with 8-quinolinol in chloroform, and the rare earths coprecipitated with spectrographic pure lanthanum hydroxide. The oxides were diluted with spec pure graphite and burned in a d-c arc. (auth)

28868 (IS-504) ANALYSIS OF CARBON MONOXIDE–NITROGEN MIXTURES BY HIGH RESOLUTION MASS SPECTROMETRY. Robert Joseph Conzemius and H. J. Svec (Ames Lab., Ames, Iowa). Feb. 1962. Contract W-7405-eng-82. 115p.

A single focusing mass spectrometer was converted into a double focusing instrument. Relatively high resolution is obtained by decreasing the slit widths and minimizing the ion-optic aberrations. A relatively low ion accelerating voltage (2000 volts) was utilized compared to those normally used for high resolution work. Essentially all of the original equipment was reused in the double focusing system. Although the original source slit was decreased from 10 to 0.4 mils and the source α value was decreased from 0.04 to 0.008 radians, sufficient sensitivity is obtained for quantitative gas analysis with the ordinary electrometer tube amplifiers utilizing 4×10^{10} ohms input grid resistors and 100% inverse feedback. Carbon monoxide–nitrogen mixtures were analyzed quantitatively. The results indicated that direct quantitative analysis can be obtained on mixtures ranging from 99 to 10% carbon monoxide in nitrogen. Analysis of lower percentages may be made possible through indirect reading of the peak should it be necessary. It appears that the instrument should be adaptable to research problems concerning these two

gases. The immediate problem posed is the analysis of oxygen and nitrogen in metals. Other applications may be possible such as analysis of metastable fragment ions of hydrocarbons or identification of doublet peaks requiring high resolution. (auth)

28869 (JEN-107-DQ/I-33) DETERMINACION ESPECTROGRAFICA DE IMPUREZAS EN TIERRAS RARAS. (Spectrographic Determination of Trace Constituents in Rare Earths). C. Capdevila and F. Alvarez (Spain. Junta de Energia Nuclear, Madrid). 1962. 13p.

A spectrographic method was developed for the determination of 18 trace elements in lanthanum, cerium, praseodymium, neodymium, and samarium compounds. The concentrations of the impurities cover the range of 0.5 to 500 ppm. Most of these impurities are determined by the carrier distillation method. Several more refractory elements are determined by total burning of the sample with a direct current arc or by the conduction briquet excitation technique with a high voltage condensed spark. The work was carried out with an automatic large quartz spectrograph. (auth)

28870 (K-1418) THE URANIUM HEXAFLUORIDE-HYDROGEN FLUORIDE FREEZING POINT CURVE AND ITS APPLICATION TO A METHOD OF ANALYSIS. R. J. Wertz and W. D. Hedge (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 31, 1960. Contract W-7405-Eng-26. 23p.

The freezing point curve for the system uranium hexafluoride–hydrogen fluoride was determined over the range 0.0 to 0.6 wt % hydrogen fluoride and is represented by the equation wt % HF = $0.0841\ \Delta t + 0.1020\ \Delta t^2 - 0.1046\ \Delta t^3 + 0.0363\ \Delta t^4$ where Δt is the depression of the freezing point of pure uranium hexafluoride in degrees centigrade. A method is presented for the determination of hydrogen fluoride in uranium hexafluoride by measuring the freezing point of the liquid phase and correlating its composition to the gross composition. The precision of the method varies with the ratio of the liquid volume of the uranium hexafluoride to the total volume of the freezing point cell and with the concentration of hydrogen fluoride in the uranium hexafluoride. (auth)

28871 (LA-1721(2nd Ed.)(Rev.)) COLLECTED RADIOCHEMICAL PROCEDURES (RADIOCHEMISTRY GROUP J-11). Jacob Kleinberg, comp. (Los Alamos Scientific Lab., N. Mex.). Jan. 1958. Contract W-7405-eng-36. 57p.

Supersedes LA-1566; LA-1567; LA-1721(1st Ed.); and LA-1722.

Revised and/or added radiochemical procedures are presented which supersede or complement those compiled previously. The procedures concern the determination of Cs, Sb, SnII, MoII, Zr^{95}, Zr^{97}, rare earth elements, UII, Cm^{242}, and Ce^{144}. (J.R.D.)

28872 (TID-11794) A COMPARISON OF THE INERT GAS-FUSION AND VACUUM EXTRACTION METHODS FOR THE DETERMINATION OF OXYGEN IN REFRACTORY METALS. Maynard E. Smith and Glenn R. Waterbury (Los Alamos Scientific Lab., N. Mex.). [1960]. Contract [W-7405-eng-36]. 13p. (LADC-4679)

The inert gas-platinum bath method was compared to the vacuum extraction method for determining oxygen in refractory metals. The inert gas-platinum bath method was preferred for analyzing metals such as Ta, Nb, Mo, V, Hf, W, and in general, gives higher results for the oxygen contents of the samples. Titanium presents a more difficult problem and requires modifications of either method. An investigation of the effects of several variables on the inert gas-platinum bath method showed it to be relatively insensitive to changes in heating period of the sample, carrier gas flow rate, and platinum concentration in the flux. The bath temperature is critical and should be higher than 1900°C, preferably at least 2100°C. (auth)

28873 (TID-12769) THE SPECTROGRAPHIC DETERMINATION OF URANIUM 235. PART V. ROUTINE APPLICATION OF A MULTIPLE HOLLOW CATHODE SOURCE ASSEMBLY AND A DIRECT-READING, LITTROW, GRATING SPECTROGRAPH. Ted Lee, Sidney Katz, and S. A. MacIntyre (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 1, 1959. Contract [W-7405-Eng-26].

The routine application of a rapid, high-precision procedure and a high resolution spectrograph to the isotopic analysis of uranium is described. The procedure, which evolved from previous developments, includes a simple sample preparation and a hollow cathode source designed for rapid sample changing. The procedure also involves a high degree of automation, and eliminates the reference measurement and background correction. The precision at the level of naturally occurring uranium (0.7115% U^{235}), measured under routine conditions, is ±2.1% of the amount present, for a single cathode determination expressed at the 95% confidence interval. In the vicinity of 90% U^{235} the precision is 0.07% of the amount present, for a single cathode determination. Approximately 7½ mins is required for a determination, including sample preparation, measurement, and calculations. The maximum capacity of the instrument is over 60 samples per 8 hr day; the instrument is presently applied to a routine load varying from 20 to 50 samples per day. In addition to the U^{235} determination, a preliminary calibration and evaluation for U^{236} is included. (auth)

28874 (TID-15916) ANALYTICAL PROCEDURES OF THE RADIOLOGICAL SAFETY LABORATORY, NEVADA TEST SITE. E. L. Geiger and Earl L. Whittaker, comps. (Reynolds Electrical and Engineering Co., Inc. Radiological Safety Div., Las Vegas, Nev.). Apr. 1961. Contract AT(29-2)-162. 85p.

Procedures used in the bioassay and environmental sample assay program are described. Concentrations, using acids and bases, preparation of carriers, sample receiving logs, labeling of solutions, standards log, and cleaning of pipets are discussed. Procedures are given for preparation of urine samples for analyses; determination of plutonium, enriched uranium, and fission products; and determination of environmental radioactivity including gross alpha and beta, gamma emitters and special samples, Sr^{89}, and Sr^{90}. Counting room operations are outlined. Safety in handling beryllium, housekeeping of the laboratory, use of equipment, laboratory manipulations, and handling chemicals are discussed. Procedures for radiological safety are outlined. (M.C.G.)

28875 (AEC-tr-5287) DETECTION OF VERY SMALL QUANTITIES OF INORGANIC GASES WITH AN IONIZATION DETECTOR. R. Lesser. Translated by Sharon Bogue (Ames Lab., Ames, Iowa) from Angew. Chem., 72: 775-7(1960). 7p.

When very small, periodic, constant amounts of gas forming organic compounds are added to ionization detectors, inorganic gases may be successfully determined up to amounts of about 10^{-5} ml. The detector used most often in gas chromatography utilizes the thermal conductivity difference between the tracer gas and the chromatographically separated inorganic gas. Since the thermal conductivity of inorganic gases are very different, such a detector produces a high detection sensitivity by using argon as a tracer gas. Hence, if a small quantity of an inorganic gas, such as hydrogen, carbon monoxide, methane, nitrogen, or oxy-

gen, is added from the column, then the high ionization current of argon plus organic gas breaks down, as long as the inorganic gas in the chamber is present, and one obtains a deflection on the recorder. The solution is the same for all gases whose ionization energies are greater than the excitation energy of argon. (N.W.R.)

28876 (AEC-tr-5291) DETERMINATION OF SEVERAL RARE-EARTH ELEMENTS BY FLAME PHOTOMETRY. N. S. Poluektov and M. P. Nikonova. Translated from Ukrain. Khim. Zhur., 25: 217-25(1959). 14p.

The possibility of determining La and Y from their radiation in an air-acetylene flame was investigated. It was found possible to determine the elements La, Eu, Y, and Yb in the total oxides of rare earths and in preparations of various individual rare earths. The addition of ammonium chloride to the solution increased the intensity of the rare earth element radiation. A method is worked out for the determination of La, Eu, Yb, and Y, based on comparative heights of peak maxima of molecular bands (La and Y) and atomic lines (Eu, Yb) as obtained from recorded spectra. The method permits the determination of an element with sensitivity of 0.1 to 0.2% (La_2O_3), 0.3% (Eu_2O_3), 0.003% (Yb_2O_3), and 0.03% (Y_2O_3) and relative precision of ±3 to 7%. With a prepared sample solution, the determination may be made in 10 min. The upper limit of determination for an element is 10 to 30% of rare earth oxide in the total oxides. (P.C.H.)

28877 QUANTITATIVE DETERMINATION OF TANTALUM, TUNGSTEN, NIOBIUM, AND ZIRCONIUM IN HIGH TEMPERATURE ALLOYS BY X-RAY FLUORESCENT SOLUTION METHOD. Marion L. Tomkins, George A. Borun, and William A. Fahlbusch (Martin Marietta Corp., Wheeling, Ill.). Anal. Chem., 34: 1260-3(Sept. 1962).

Tantalum, tungsten, niobium, and zirconium can be determined satisfactorily by x-ray fluorescence analysis of liquid samples after chemical separation of the elements from high temperature alloy matrices. Using scattered radiation as an internal standard, interelement effects and instrumental variations are minimized. Relative standard deviations of about 2% are readily attainable. The method is applicable to any alloy from which the desired elements can be separated. (auth)

28878 THERMAL ANALYSIS OF PHOSPHOR RAW MATERIALS. R. C. Ropp and M. A. Aia (Sylvania Electric Products, Inc., Towanda, Penna.). Anal. Chem., 34: 1288-91(Sept. 1962).

The thermal analyses of several phosphor raw materials are given to illustrate the methods as well as to show limitations and means of circumventing experimental difficulties. The data show that a combination of differential thermal analysis and thermogravimetric analysis is often needed to establish reaction temperatures and products of formation of the material being investigated. (auth)

28879 SEMIXYLENOL ORANGE: A SENSITIVE REAGENT FOR ZIRCONIUM. D. C. Olson and D. W. Margerum (Purdue Univ., Lafayette, Ind.). Anal. Chem., 34: 1299-1302(Sept. 1962).

A metallochromic indicator of the sulfonphthalein nitrilodiacetate type, given the name semixylenol orange, was isolated, purified, and characterized. It forms several complexes with zirconium(IV) including a 1:1 complex in 2M perchloric acid, a polymeric zirconium complex in 1M perchloric acid, and another complex with a large excess of the indicator. The latter complex has an average molar absorptivity (based on Zr) of 59,000 at 535 mμ and is an extremely sensitive analytical reagent for zirconium. (auth)

28880 DIRECT SPECTROPHOTOMETRIC FLUORIDE DETERMINATION. S. S. Yamamura, M. A. Wade, and J. H. Sikes (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem., 34: 1308-12(Sept. 1962).

Fluoride reacts with the wine-red chelate of cerium(III) and alizarin complexone to form a lilac-blue double complex. As the basis for a colorimetric method for microgram levels of fluoride, two ratios of cerium(III) to alizarin complexone are used. A 1:1 mole ratio gives high tolerance for common anions that do not complex cerium(III) as well as for many cations. A 1:2.5 ratio gives increased tolerance for complexing anions such as sulfate and phosphate. These effects are explained by a consideration of various equilibria involved. Use of a 20% acetonitrile or acetone medium rather than water alone increases both the sensitivity of the reaction and the stability of the complexes. The sensitivity, with a 1:1 mole ratio reagent in the acetonitrile medium, is 1.4×10^{-3} μg of fluoride per cm^2. Data are presented showing the usefulness of the method for the direct determination of fluoride in natural waters and for the analysis of complex inorganic samples following a pyrolysis separation. (auth)

28881 DETERMINATION OF OXIDES AND NITRIDES IN LITHIUM METAL BY HIGH-TEMPERATURE FLUORINATION WITH POTASSIUM BROMOTETRAFLUORIDE. Gerald Goldberg (Oak Ridge National Lab., Tenn.). Anal. Chem., 34: 1343-4(Sept. 1962).

The $KBrF_4$ method was found to be routinely applicable to the determination of oxygen and nitrogen, as contaminants, in lithium metal. The range of oxygen and nitrogen that can be measured conveniently is from 0.02 to 10 mg. (P.C.H.)

28882 METHOD FOR DETERMINATION OF URANIUM IN TRIBUTYL PHOSPHATE AND KEROSENE SOLUTIONS. J. Petrement Eguiluz and F. Palomares Delgado. Anales real soc. españ. fís. y quím. (Madrid), Ser. B, 57: 745-50 (Dec. 1961). (In Spanish)

An analytical method for the determination of uranium in organic solutions of tributyl phosphate and kerosene is proposed. Uranium is re-extracted from the aqueous phase by reduction with cadmium in acid solution. The uranium can be determined in this solution by the usual methods. In case of very diluted solutions, a direct spectrophotometric determination of uranium in the organic phase with dibenzoylmethane is proposed. (auth)

28883 ANALYSIS OF HEAVY WATER AT NEAR NATURAL WATER CONCENTRATIONS. [PART] II. J. L. Otero de la Gandara, M. Gispert Benach, and J. L. Rojas. Anales real soc. españ. fís. y quím. (Madrid), Ser. B, 57: 827-32(Dec. 1961). (In Spanish)

28884 THE DETERMINATION OF TANTALUM AND NIOBIUM. M. H. Cockbill (London and Scandinavian Metallurgical Co. Ltd., London). Analyst, 87: 611-29(Aug. 1962).

A review is given on the separation of Nb and Ta from other substances and their separation from each other. The various methods considered are: hydrolysis, gravimetric, chromatographic, ion exchange, chlorination, liquid-liquid extraction, reduction of Nb, colorimetric, spectrographic, x-ray fluorescence, and radioactivation. A general method for all samples is outlined. 183 references are included. (P.C.H.)

28885 NUCLEAR PURITY CONTROL OF ZIRCONIUM. K. Einfeld, E. Ruppert, and R. Tornau (Interatom, Internationale Atomreaktorbau GmbH, Bensberg, Ger.). Atomwirtschaft, 7: 312-16(June 1962). (In German)

The purity control of zirconium, because of its increasing use in certain reactor types, is of great importance.

The applicability of two different nuclear processes for the nondestructive measurement of contamination in large quantities of Zr was studied. The first method involves the determination of the Hf concentration by a neutron activation analysis. A γ-γ coincidence technique is used to isolate the Hf^{181} activity, which can be determined to ±5 ppm. A subtraction method can also be used to determine the Hf^{181} activity. The second nuclear process involves the heterogeneous build-up of the Zr rods under test into a grid and the filling of the interstices with a moderator for slowing down neutrons. The method of pulsed neutron fields in which the decay time of a pulsed thermal neutron field is detected is used for the measurement. It is possible, by this process, to determine the nuclear contamination of Zr with an accuracy of 2.5%. Comparison of the two processes, neutron activation analysis and pulsed neutron field analysis, indicates that a combination of the two methods is necessary for the complete determination of the impurities in Zr. (auth)

28886 DETERMINATION OF ^{90}Sr AND ^{90}Y CONCENTRATIONS IN CONTAMINATED NATURAL WATERWAYS. M. H. François and M. Jezequel (Service de Controle des Radiations et de Genie Radioactif, Fontenayaux-Roses, France). Centre belge étude et docoment. eaux, Bull. trimestr. CEBEDEAU, 4: No. 50, 269-71(1960). (CEA-1965) (In French)

With the aim of measuring low concentrations of Sr^{90} in natural waters liable to be contaminated by radioactive waste or fallout, a complexometric separation of Y^{90} was studied. The conventional methods recommended for Sr^{90} concentration measurements generally use nitric precipitations and lead to manipulations which, especially in the case of highly contaminated natural waters, are often very troublesome. A fast and easily applied technique was needed giving an acceptable approximation. A study was made of the complex which o-thenoyltrifluoro-acetone (TTA) in benzene solution forms with yttrium. (auth)

28887 THE DETERMINATION OF OXYGEN IN ZIRCONIUM BY RADIOACTIVATION WITH 14-Mev NEUTRONS. E. Cerrai and F. Gadda (Laboratori CISE, Segrate, Milan). Energia nucleare (Milan), 9: 317-25 (June 1962). (In English)

The determination of oxygen in two zirconium specimens was carried out by radioactivation with 14-Mev neutrons through the $O^{16}(n,p)N^{16}$ reaction. Fast neutrons were produced by bombarding with a 150 kv static accelerator a Ti-T target with deuterons. A source intensity of 10^9 neutrons/sec was obtained. Specimens in the form of 20 mm diameter disks were irradiated at the same time of reference standards. As a reference, SAP disks having a known content of oxygen were used. Due to the short half life of N^{16} (7.4 sec) the oxygen measurements were done referring to the activity of aluminum (Mg^{27}) which had been previously calibrated toward oxygen. Therefore the same measurement method can be applied to aluminum. Specimens were rapidly transferred from the irradiation facility to the counting room by means of a pneumatic circuit 30 m long. The sensitivity of the method described is about 1 to 2 mg O_2 per g Zr and the accuracy within ±10%. With suitable corrections of measurements and a different counting method, sensitivity could be increased. (auth)

28888 METHODS AND STANDARDS IN RADIOANALYSIS OF WATER. S. A. Reynolds (Oak Ridge National Lab., Tenn.). Health Phys., 8: 391-6(Aug. 1962).

Methods and standards for chemical methods and the measurement of radionuclides in the radiochemical analysis of water are discussed. An attempt is made to set up logical criteria for the methods and standards. (P.C.H.)

28889 DETERMINATION OF Sr^{90} IN MILK. C. W. Thomas (General Electric Co., Richland, Wash.). Health Phys., 8: 407-10(Aug. 1962). (HW-SA-2011)

A procedure is described for the determination of Sr^{90} in milk which is rapid, simple, and yields 90% recovery. Strontium is removed from large volumes of buffered milk with a cation resin and at the same time is separated from troublesome anions. The column is then stripped, and the strontium and calcium separated. Removal of interfering anions allows the strontium to be precipitated as the nitrate, with concentrated nitric acid instead of the conventional fuming nitric acid. After Y^{90} has grown to equilibrium in the precipitate, it is extracted and measured to evaluate the Sr^{90}. (auth)

28890 REPORT ON FISSION RADIONUCLIDES OF HEALTH SIGNIFICANCE IN FOODS AND FEEDING MATERIALS. A. Schwebel (National Bureau of Standards, Washington, D. C.). J. Assoc. Offic. Agr. Chemists, 45: 774-5 (Aug. 1962).

The currently reported methods for the detection and determination of Sr^{90}, Sr^{91}, I^{131}, and Cs^{137} in milk, vegetation, and other biota are very long. It is recommended that studies be made to develop screening methods and precise and rapid methods for the determination of these radionuclides in foods and feeding materials. (C.H.)

28891 ANALYSIS OF FOODS FOR CESIUM-137. Harry M. Yakabe, James M. Dimitroff, and Edwin P. Laug (Food and Drug Administration, Washington, D. C.). J. Assoc. Offic. Agr. Chemists, 45: 775-81(Aug. 1962).

The determination of the radionuclide cesium-137 in raw foods and food ash by multi-channel gamma spectroscopy is described. The detector, a 3 × 3″ sodium iodide (thallium activated) crystal, is heavily shielded by a 24 × 27 × 36″ shield. The lower limit of sensitivity of the method is about 10 pc/kg of food sample. Values are presented that were obtained on 102 samples during the current surveillance program for fall-out contamination in foods. Values obtained range from non-detectable amounts of cesium-137 to a high of 531 pc/kg in a sample of cottonseed meal. Analysis of bran and flour milled from an original wheat sample show that bran contains 2 to 2.5 times the amount of cesium-137 per kilogram of original material as that found in the flour and wheat. Data are also presented to show that considerable losses of cesium-137 by volatilization can occur if ashing temperature exceeds 450°C. (auth)

28892 DETERMINATION OF MERCURY IN PLANT MATERIALS BY QUANTITATIVE ISOTOPE DILUTION ANALYSIS. ANALYTICAL CHEMISTRY OF TRACE ELEMENTS AND MINERAL CONSTITUENTS IN BIOLOGICAL MATERIALS. XXI. Nobuo Suzuki (Tohoku Univ., Sendai, Japan). Sci. Repts. Tohoku Univ., First Ser., 43: 161-70 (Oct. 1959). (In English)

It is difficult to determine accurately mercury in plant materials, since the methods adequate for preventing the unavoidable loss of mercury during destruction of organic matters and for determining micro-quantities of mercury with ease and reliability are not yet firmly established. Determination of mercury in plant materials was attempted by means of quantitative isotope dilution analysis after fundamental experiments using Hg^{203} as tracer. The method depends on the same principle as the isotope dilution method, permits correction due to loss of the elements in question, is convenient in operation, and superior both in sensitivity and accuracy to the chemical methods hith-

erto in practice, because the final determination is made only by the radioactivity measurement. Dithizone being used as reagent, extraction condition, dithizone-mercury ratio, influence of coexisting metals, destruction of dithizonate, and blank value of mercury in acids were investigated. Determination of mercury in rice was finally carried out. (auth)

28893 A NEW REDUCTIMETRIC REAGENT: IRON(II) IN A STRONG PHOSPHORIC ACID MEDIUM. TITRATION OF URANIUM^{VI} WITH IRON^{II} AT ROOM TEMPERATURE. G. Gopala Rao and Seetarama Raju Sagi (Andhra Univ., Waltair, India). Talanta, 9: 715-22(Aug. 1962). (In English)

The formal redox potential of the Fe^{III}/Fe^{II} couple was determined in media of varying phosphoric acid concentration and found to decrease steeply with increasing phosphoric acid concentration. Above a certain concentration of phosphoric acid, the difference between the formal potentials of the U^{VI}/U^{IV} and Fe^{III}/Fe^{II} couples becomes sufficiently great to enable iron^{II} to reduce uranium^{VI} even at room temperature. This is the reversal of the normal redox reaction—oxidation of uranium^{IV} by iron^{III}. A careful study of the various factors involved enabled the development of a new reductimetric titration of uranium^{VI} with iron^{II} in strong phosphoric acid medium (11.0 to 13.5M) at room temperature using either a potentiometric end point or a visual end point with methylene blue or thionine as an internal redox indicator. Because the new procedure enables the titration to be carried out at room temperature, it is more convenient than procedures involving titanium^{III} and chromium^{II} which require temperatures ranging from 60 to 90°C. The new procedure has a further advantage in that it can be used for the determination of uranium^{VI} even in the presence of iron^{III} and tungsten^{IV}, using an electrometric end point. Also, the new procedure does not require the elaborate precautions which are necessary for the preparation and storage of titanium^{III} or chromium^{II} solutions. (auth)

28894 PHOTOMETRIC DETERMINATION OF URANIUM IN CALCIUM FLUORIDE WITH 1-(2-PYRIDYLAZO)-2-NAPHTHOL (PAN) USING 1,2-DIAMINOCYCLOHEXANE-TETRA-ACETIC ACID AS MASKING AGENT. K. L. Cheng (RCA Labs., Princeton, N. J.). Talanta, 9: 739(Aug. 1962). (In English)

A procedure is given for determining 10 to 100 μg U in 0.1 g CaF_2. The procedure is based on the use of 1,2-diaminocyclohexanetetra-acetic acid to mask the PAN complexes of interfering metals, the extraction of the U-PAN complex by dichlorobenzene, and the measurement of the absorbance at 570 mμ. (D.L.C.)

28895 ACTIVATION ANALYSIS OF THE IMPURITIES IN BISMUTH METAL. Ryuhei Kurosawa. Waseda Daigaku Rikogaku Kenkyujo Hokoku, No. 18, 15-25(Dec. 1961).

The presence of micro-amounts of impurities in Bi metal enhances the characteristics of semiconductor and chain reactions, especially the coolant in the reactor. Since Ag, Au, Cl, and Cd have relatively high neutron absorption cross sections, these impurities in Bi samples were determined by means of activation analysis and γ-ray spectrometry by a multi-channel pulse height analyzer. The results obtained by irradiating the samples in the JRR-1 reactor with a neutron flux of 3×10^{11} n/cm^2/sec for 15 to 45 hr followed by chemical analyses (shown by diagrammatic separations) are described. The minimum error was 7.7%. (OID)

28896 FLUORIMETRIC DETERMINATION OF SCANDIUM. I. M. Korenman and V. S. Efimychev (Lobachevskii State Univ., USSR). Zhur. Anal. Khim., 17: 425-8(July 1962). (In Russian)

Salicylalsemicarbazide was studied as a luminescent reagent for scandium. The reagent was used for the quantitative determination of scandium both in pure solutions and in the presence of salts of a number of other elements. (auth)

28897 SEPARATION OF SMALL AMOUNTS OF RARE EARTHS FROM MINERALS AND ROCKS BY CHLORINATION WITH CARBON TETRACHLORIDE. N. Iordanov and Khr. Daiev (Inst. of General and Inorganic Chemistry, Bulgarian Academy of Sciences, Sofia). Zhur. Anal. Khim., 17: 429-31(July 1962). (In Russian)

By chlorination of the separated rare earth, iron, and aluminum oxides with carbon tetrachloride at 500–600°C, it is possible to quantitatively separate iron, aluminum, and other elements which interfere in the photometric determination of rare earths with arsenazo. The method developed permits the determination of large quantities of rare earths (up to 20 γ) in minerals and rocks in a 0.5–1 g sample. (auth)

28898 ACTIVATION-CHROMATOGRAPHIC ANALYSIS OF RARE EARTHS. D. I. Ryabchikov and V. A. Ryabukhin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 432-41(July 1962). (In Russian)

An activation-chromatographic method for the analysis of mixtures and pure rare earths was developed permitting the determination of individual rare earths with high sensitivity and accuracy of about ±5–10%. A special apparatus was devised and conditions for the chromatographic separation of 0.1–1.0 mg of the sum of oxides were studied. The determination of Tm and Ho admixtures in pure samples of Er has been carried out with the sensitivity of 8×10^{-4} and 1×10^{-4}% correspondingly, and of Tm in natural mixtures of rare earths with the sensitivity of up to 1×10^{-3}%. (auth)

28899 PHOTOMETRIC DETERMINATION OF MICROGRAM QUANTITIES OF YTTRIUM, LANTHANUM AND SCANDIUM IN $Y_2O_3-La_2O_3$, $Y_2O_3-Sc_2O_3$, $La_2O_3-Sc_2O_3$ MIXTURES. N. N. Sentyurina. Zhur. Anal. Khim., 17: 442-6(July 1962). (In Russian)

A photometric method was developed for the determination of Y, La, and Sc in double mixtures of their oxides by means of thoron II. For the double mixtures with scandium the method is based on the measurement of the total optical density of hydrochloric acid solutions with thoron II at pH 4.0 on condition that the sum of the oxides is known. For $Y_2O_3-La_2O_3$ mixtures the method is based on the measurement of the total optical density of citric acid solutions of the Y and La complexes with thoron II at pH 2.7 and 4.5. The errors of individual determinations of 40–80 γ of the sum of the oxides are within ±10%. (auth)

28900 USE OF CINNAMIC ACID IN ANALYTICAL CHEMISTRY. COMMUNICATION 2. SEPARATION OF TITANIUM, ZIRCONIUM AND THORIUM FROM MANGANESE, NICKEL, COBALT AND ZINC. E. A. Ostroumov and I. I. Volkov (Inst. of Oceanology, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 461-5(July 1962). (In Russian)

It was established that ammonium cinnamate quantitatively precipitates titanium from a weakly acid solution on heating; manganese, nickel, cobalt, and zinc remain in the solution. The pH value during the precipitation becomes equal to about 5.0. Zirconium and thorium are also quantitatively precipitated and may be separated from the above

bivalent metals. The precipitates of titanium, zirconium, and thorium cinnamates are isolated in a solid form; the sorption of the bivalent metals by the precipitates is in the limits of hundredth parts of a milligram. Sulfate and nitrate ions do not interfere. (auth)

28901 SPECTROCHEMICAL DETERMINATION OF SMALL CONCENTRATIONS OF NIOBIUM AND TANTALUM IN ROCKS. I. A. Krinberg and V. D. Tsykhanskii (Inst. of Geochemistry, Academy of Sciences, Siberian Dept., Irkutsk, USSR). Zhur. Anal. Khim., 17: 466-70 (July 1962). (In Russian)

A spectrochemical method for the determination of small quantities of niobium and tantalum in rocks was developed including a preliminary chemical concentration with the use of phenyl-arsonic acid for the precipitation of the elements together with titanium followed by a spectrographic analysis of the products of concentration. The determination of niobium and tantalum is possible when their concentration in rocks is not less than 5×10^{-5}%; the probable experimental error is about 7% for niobium and 9% for tantalum. (auth)

28902 EXTRACTION-PHOTOMETRIC METHOD FOR THE DETERMINATION OF PROTACTINIUM(V) WITH ARSENAZO III. E. S. Palshin, B. F. Myasoedov, and P. N. Palei (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 471-5(July 1962). (In Russian)

A sensitive color reaction between Pa(V) and arsenazo III is described. The molar extinction coefficient of solutions of the protactinium–reagent compound at 680 μ is 2.2×10^4. An extraction-photometric method for the determination of protactinium with arsenazo III was worked out. The method includes the extraction of the protactinium–arsenazo III complex from 7 $\underline{N}$ H_2SO_4 solutions with isoamyl alcohol, washing the extract with a 0.5 $\underline{M}$ solution of oxalic acid in 7 $\underline{N}$ H_2SO_4, and measurement of the optical density of the extract. The method permits the determination down to 0.3 γ of protactinium in 1 ml in the presence of large quantities of Al, Fe, Ni, Mn(II), Cr(III), La, and in the presence of milligram quantities of U(VI), Nb(V), Zr(IV), Th(IV), and other elements. (auth)

28903 USE OF THE METHOD OF AMPEROMETRIC TITRATION WITH TWO INDICATOR ELECTRODES FOR THE VOLUMETRIC DETERMINATION OF URANIUM. N. I. Udaltsova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 476-80(July 1962). (In Russian)

The method of amperometric titration with the use of two indicator electrodes–dead stop end point was used for titration of uranium(IV) with a number of oxidizers: $(NH_4VO_3$, $Ce(SO_4)_2$, $K_2Cr_2O_7$, $KMnO_4$, and $NH_4Fe(SO_4)_2$. The method permits the determination of smaller quantities of uranium (down to about 1.5 γ/ml) with higher accuracy than the ordinary method of amperometric titration or a potentiometric method. (auth)

28904 EXTRACTION-LUMINESCENCE METHOD FOR THE DETERMINATION OF URANIUM IN SOILS, SILT, PLANTS AND ANIMAL TISSUES. A. A. Nemodruk and I. E. Vorotnitskaya (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 481-5(July 1962). (In Russian)

A simple and satisfactorily accurate method was developed for the determination of uranium in soils, silt, plants, and biological materials, including its preliminary separation from interfering elements by extraction with a solution of tributyl phosphate in toluene from solutions containing ammonium nitrate as a salting out agent at pH 2.5–3.0. Uranium is stripped from the extract with an ammonium carbonate solution, NaF is added to the strip solution, it is evaporated to dryness and ignited at 500°, and the concentration of uranium is determined by luminescence intensity of the beads prepared. When a photoelectric luminescence photometer is applied, the error of the determination of 0.4–2.75 γ of uranium in a sample is not more than 7.5%. (auth)

28905 THE EFFECT OF THE CONCENTRATION OF HYDROGEN IONS ON THE LUMINESCENCE DETERMINATIONS OF URANIUM(VI) IN URANYL NITRATE SOLUTIONS. T. S. Dobrolubskaya (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 486-8(July 1962). (In Russian)

The sensitivity of the luminescence determinations of uranium(VI) in diluted aqueous solutions is influenced, to a considerable degree, by the ionic state of uranium in solution. It is more suitable to use the short-wave ultraviolet radiation for exciting the luminescence of diluted solutions of uranyl salts. (auth)

28906 PHOTOMETRIC DETERMINATION OF TECHNETIUM BY MEANS OF FURIL α-DIOXIME IN HYDROCHLORIC ACID SOLUTIONS. A. F. Kuzina (Inst. of Physical Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 489-91(July 1962). (In Russian)

A new photometric method was developed for the determination of technetium by means of furyl α-dioxime in the presence of $SnCl_2$. The color depends on the concentration of HCl and technetium. The best results are obtained in a medium of 1 $\underline{N}$ HCl. (auth)

28907 DETERMINATION OF ETHYLENEDIAMINE-TETRA-ACETIC ACID AND RARE EARTHS WHEN THEY ARE PRESENT TOGETHER. G. S. Tereshin and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, Moscow). Zhur. Anal. Khim., 17: 526-7(July 1962). (In Russian)

A simple and rapid volumetric method is suggested for the successive determination of EDTA and rare earths in the same sample of solution. The total concentration of EDTA is determined by titration with iron (III) chloride at pH about 2 and at the temperature 60–70° (sulfosalicylic acid is used as an indicator) followed by the titration (at pH about 6 with an urotropine buffer solution) of the rare earth ions with complexone III using xylenol orange as an indicator. (auth)

28908 THE EFFECT OF FLUORIDES ON THE DETERMINATION OF URANIUM IN THE PRESENCE OF BERYLLIUM. P. N. Palei and Z. K. Karalova. Zhur. Anal. Khim., 17: 528-9(July 1962). (In Russian)

The effect of fluorides on the determination of uranium by the methods of oxidimetric and complexometric titration in the presence of high concentrations of beryllium was determined. (auth)

28909 ON THE DETERMINATION OF BORON IN TECHNICAL BORON. M. G. Vasileva and A. L. Sokolova (Physico-Technical Inst., Academy of Sciences, Sukhumi, Georgian SSR). Zhur. Anal. Khim., 17: 530-1(July 1962). (In Russian)

When boron is determined in elementary boron, it is suitable to use potassium persulfate in a mixture with hydrogen peroxide for dissolution. In this case accurate and satisfactorily reproducible results are obtained. (auth)

28910 METODY ANALIZA ESTESTVENNYKH RADIOAKTIVNYKH ELEMENTOV. (Analytical Methods for Natural Radioactive Elements). V. L. Shaskhin. Moscow, Gosatomizdat, 1961. 150p.

Radiometric methods for the determination of natural radioactivity, classified into uranium, thorium, and potassium groups, are discussed. Radiometric analysis not requiring chemical separation is reviewed. Methods for the determination of the isotopic composition of uranium, thorium, protactinium, actinium, radium, polonium, and complex ores and minerals are also described. (R.V.J.)

28911 SPEKTRAL'NYI ANALIZ MINERAL'NOGO SYR'YA. (Spectral Analysis of Mineral Resources). S. K. Kalinin and E. E. Fain. Alma-Ata, Kazakh SSR, Publishing House of the Academy of Sciences, 1962. 240p.

A review is given of spectral analysis of natural resources. Spectral excitation by electric arc, practical applications of spectral analysis, determination of chemical elements, and sensitivity are discussed. The book is designed for spectroscopy specialists handling chemical analyses of ores and minerals. 169 references are included. (R.V.J.)

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Refer also to abstract 29216.

28912 (60GL218) OXIDATION KINETICS OF PYROLYTIC GRAPHITE. W. S. Horton (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Dec. 30, 1960. 28p.

Kinetic data are presented for the oxidation of pyrolytic graphite in air and nitrogen-diluted air at 614 to 1568°C. A flowing system was used at atmospheric pressure with linear flow rates from 16 to 30 cm per minute. By using dimensional changes the overall rate was corrected for that on the edge and the net rate on the faces of the specimens, which corresponds to the basal plane of the ideal graphite structure, was obtained. Neither gas velocity nor diffusion affected the observed rates which were of one-half order with respect to oxygen concentration. The observed activation energy was about 35 kcal per gram atom of carbon consumed. A mechanism is based upon fast attainment of equilibrium between gaseous oxygen and surface oxide complexes (C−O sites) for which the equilibrium constant depends upon the one-half power of oxygen concentration in the gas stream. The rate limiting step would be the dissociation of product molecules from the surface at a speed dependent upon the surface concentration of the complex sites. The edges oxidized faster than the basal plane faces by a factor of about 2.5 and this ratio appeared to increase with temperature. At 950°C a representative spectrographic graphite oxidized in normal air about two orders of magnitude faster than the basal plane of pyrolytic graphite. (auth)

28913 (ANL-6475) KINETICS OF THE REDUCTION OF URANIUM OXIDES BY CARBON MONOXIDE AND BY HYDROGEN. Final Report, Program 9.6.1. Milton Volpe and Slavko Mihailovich (Argonne National Lab., Ill.). July 1962. Contract W-31-109-eng-38. 22p.

The kinetics of the reduction of some powdered uranium oxides ($UO_{2.1}$, $UO_{2.2}$, $UO_{2.4}$, U_3O_8) by hydrogen and carbon monoxide was studied by means of a static method. Reductant pressures of about one millimeter of mercury were used, and reaction temperatures ranged from 590 to 950°C. It was found that for all oxide compositions and for reduction by carbon monoxide as well as by hydrogen, the reduction was controlled by a surface process whose rate expression was $-dP/dt = [k_0e^{-E/RT}]\,P^n$. The exponent n was unity for hydrogen and two-thirds for carbon monoxide. The activation energy E was approximately independent of the nature of the reducing gas. It did depend upon the structure of the oxide, being about 25 kcal/mole for U_3O_8 and about 10 kcal/mole for the other compositions. (auth)

28914 (BMI-1591) THE VOLATILITY OF PuO_2 IN NONREDUCING ATMOSPHERES. Stan J. Paprocki, Donald L. Keller, Carl A. Alexander, and William M. Pardue (Battelle Memorial Inst., Columbus, Ohio). Aug. 16, 1962. Contract W-7405-Eng-92. 16p.

The vapor pressure of plutonium dioxide (PuO_2) was investigated in the temperature range 1450 to 1775°C (1723 to 2048°K) in air, argon, and oxygen atmospheres by a transpiration technique. Data and thermodynamic calculations showed that PuO_2 can vaporize congruently or as a suboxide species, probably PuO, depending on the atmosphere. The ΔH°_{298} for vaporization in 1 atm of oxygen is 153,800 cal per mole. The standard free energy of formation (ΔG°_f) of gaseous PuO_2 is −121,000 + 10.7T from 1227 to 1827°C (1500 to 2100°K). The calculated erosion loss is approximately 3 mils per yr at 1705°C (1978°K). (auth)

28915 (GA-3337) CARBIDE CATHODE STUDIES, PHYSICAL AND CHEMICAL REDEPOSITION. Quarterly Progress Report, April 1, 1962–June 30, 1962. A. F. Weinberg, L. Yang, and S. Langer (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 18, 1962. Contract NAS 3-2301. 23p.

The utilization of physical and chemical processes to reduce the rate of vapor loss of thermionic emitters composed of mixed carbides of U and Zr in order to increase the permissible operating temperature is being studied. Preliminary, qualitative results obtained from study of physical redeposition processes showed that increasing the collector temperature may markedly reduce the rate of weight loss from a UC emitter operating at 2053°K. The requisite experimental equipment for studies of chemical transport processes was designed and constructed. Experiments will proceed through both a physical chemistry approach to an understanding of the transport processes and a technique to evaluate the efficacy of possible combinations of chemical species by monitoring the electron emission from diodes containing such mixtures. (auth)

28916 (K-1117) CALCIUM FLUORIDE AS A SORBENT FOR HYDROGEN FLUORIDE. W. L. Colvin (Union Carbide Nuclear Co. K-25 Plant, Oak Ridge, Tenn.). May 21, 1954. Contract W-7405-eng-26. 12p.

A high surface area (129 cm^2/g) calcium fluoride, prepared by direct fluorination of calcium sulfate, was found to be an excellent sorbent for hydrogen fluoride; it sorbed an average of 12% by weight of hydrogen fluoride over 8 sorption cycles. Desorption was easily accomplished either by heating to 150°C and purging with an inert gas or evacuating for 3 to 4 hours at 100°C. No operational difficulties, such as dusting, plugging, or fusion, were encountered. (auth)

28917 (NAA-SR-7314) ELECTROMOTIVE FORCE, POLAROGRAPHIC, AND CHRONOPOTENTIOMETRIC STUDIES IN MOLTEN BISMUTH–BISMUTH TRIBROMIDE SOLUTIONS. L. E. Topol and R. A. Osteryoung (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Aug. 15, 1962. Contract AT(11-1)-Gen-8. 20p.

Electromotive force (emf) and polarographic measurements on cells of the type C, $Bi(N_1)$, $BiBr_3(1-N_1)$ || $BiBr_3(1-N_2)$, $Bi(N_2)$, C where N denotes mole fraction and N_2 varied from 10^{-4} to about 0.08, were made at 226, 235,

250, 275, 300, and 325°C. In addition a chronopotentiometric study was performed on a cell containing N_2's of 0.0027 to 0.0210 at 285 to 290°C and N_2 = 0.0027, 0.0072, and 0.0128 at 240°C. The emf and polarography results were similar to those found in the Bi–$BiCl_3$ system. The emf data were consistent with the reaction 4 BiBr = Bi_4Br_4, and the equilibrium constant, K_N, can be expressed as log K_N = (2.83 ± 0.83) (10^3/T°K – 1.852) + 3.98 ± 0.25 for N_{Bi} < 0.08. It was also found that if liquid junction potentials are not negligible, Bi_4Br_5 instead of Bi_4Br_4 species may actually be present. Polarograms yielded anodic waves indicating the oxidation of a soluble entity, and it was concluded that the electrode reaction is probably reversible. Anodic limiting current vs Bi concentration plots were linear to about 0.2 mole per cent Bi, and an activation energy of 5.1 ± 0.9 kcal was determined for the current-limiting process. The chronopotentiograms appear to indicate that oxidation of the bismuth species occurs without any apparent complications. The transition time constant, $i\tau^{1/2}/C$, was found to vary somewhat with concentration at each temperature and also increased with decreasing current. However, plots of the average $i\tau^{1/2}$ vs C for all the runs resulted in straight lines at each temperature, and diffusion coefficients of about 0.62×10^{-5} and 0.30×10^{-5} cm^2/sec at 285 and 240°C, respectively, and an activation energy of diffusion of 7.3 kcal were calculated. (auth)

28918 (ORNL-TM-302) PREPARATION OF HIGH-PURITY MAGNESIUM OXIDE. R. B. Quincy, Jr. (Oak Ridge National Lab., Tenn.). Aug. 15, 1962. Contract [W-7405-eng-26]. 7p.

A procedure was developed for preparing high-purity magnesium oxide for use in growing single crystals needed in studies of radiation effects. The procedure consists in dissolving high-purity sublimed magnesium metal in nitric acid, extracting impurities from the solution into a TTA–Hexone solution, precipitating magnesium carbonate from the aqueous phase, and igniting the magnesium carbonate to magnesium oxide. Amounts of magnesium oxide from gram to pound quantities can be prepared. (auth)

28919 (ORNL-TM-310) X-RAY DIFFRACTION STUDY OF Cs_3ZrF_7. G. D. Robbins and J. H. Burns (Oak Ridge National Lab., Tenn.). Aug. 7, 1962. Contract [W-7405-eng-26]. 7p.

A single-crystal x-ray diffraction study of Cs_3ZrF_7 was made, in which the unit-cell dimensions and probable space groups were determined and the metal-ion positions deduced. The face-centered cubic unit cell has a = 9.70 ± 0.02Å, and the space group is $F\bar{4}3m$, F432 or Fm3m. The metal ions lie on or near the following positions: Zr^{4+} at (0,0,0) + face-centering and Cs^+ at ($\frac{1}{2},\frac{1}{2},\frac{1}{2}$; $\frac{1}{4},\frac{1}{4},\frac{1}{4}$; $\frac{3}{4},\frac{3}{4},\frac{3}{4}$) + face-centering; but the fluoride-ion arrangement is disordered. This compound is apparently isotopic with K_3ZrF_7, $(NH_4)_3ZrF_7$, and K_3UF_7 as regards the metal ions, but no comparison can be made from this work as to the exact arrangement of the fluoride ions. The x-ray powder pattern is given for use in identification. (auth)

28920 (TID-12161) THE SOLUBILITY OF PLUTONIUM SALTS IN AQUEOUS SOLUTIONS UP TO 300°C. B. C. Blanke, E. N. Bousquet, and R. H. Steinmeyer (Mound Lab., Miamisburg, Ohio). [Mar. 10, 1961]. Contract AT(33-1)-Gen-53. 22p.

Plutonium solutions were studied to determine if a salt could be found that was sufficiently soluble in aqueous solution to be used as an aqueous homogeneous fuel. The method used was the direct observation of the formation of a precipitate in a sealed quartz microtube. Studies were made of tri-, tetra-, and hexavalent plutonium salts such as the phosphate, sulfate, chloride, and carbonate as a function of temperature and acid concentration. The composition of the precipitates formed were not determined. The range of temperatures varied from ambient to that of the critical temperature of water. The acidity varied from 0.2 to 16 molar. (auth)

28921 (TID-15718) ANNUAL RESEARCH REPORT [ON MINERAL ENGINEERING] NOVEMBER 1, 1961 TO OCTOBER 31, 1962. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-956. 5p.

A summary of research on the fundamental principles of flotation and leaching is presented. In surface chemistry and flotation research, the behavior of chloride and nitrate ions at the solid-liquid interface was evaluated by titrating ferric oxide suspension with HCl and NaCl in the presence of 2M $NaNO_3$. Results indicate that even in the presence of a large excess of nitrate, the chloride ion is able to displace the nitrate ion in the electric double layer. Other research was started on adsorption of sodium hexadecyl sulfonate on Fe_2O_3, and research is in progress on mixed adsorption of water vapor and primary amine vapors on ferric oxide. The kinetics of ZnS dissolution in aqueous H_2SO_4 were studied and a probable mechanism of the leaching reaction was postulated. Results of an experiment concerning the interaction between two bodies separated by a fluid electrolyte are being prepared for presentation in a thesis. (J.R.D.)

28922 (TID-16293) ON THE PHYSICAL CHEMISTRY OF RARE EARTH ELEMENTS AND THEIR COMPOUNDS. Final Report. LeRoy Eyring (Iowa. State Univ., Iowa City). [nd]. Contract AT(11-1)-72. 71p.

A résumé of the project is given in which research personnel and their publications from these investigations are listed. It is noted that, in addition to the published work, annual progress reports were issued which give an account of work in past years, and oral presentations were made in the U. S. and foreign countries. Information concerning the 1961 Summer program is included concerning separate structures studies using Guinier cameras and high-temperature diffractometers, and by single crystal studies and neutron diffraction. Other work in this program concerns pycnometric measurements of PrO_x density as a function of x, kinetic studies of $PrO_{1.83}$ oxidation to PrO_2, and an investigation of pressure-composition relations in the Pr–O system under isothermal conditions. Observations are also included concerning the reaction Pr + $\frac{3}{2}$ H_2O = $PrO_{1.5}$ + $\frac{3}{2}$ H_2. Miscellaneous procedures presented for use in studies of rare earth metal-N systems include a method for N determination, preparation of cerium nitride, and conductivity of LaN_x systems. A summary of recent work on rare earth oxide systems is also presented. (J.R.D.)

28923 (TID-16464) INFRARED IDENTIFICATION OF SILICA ADSORBED ON THORIA SURFACES. Technical Report No. XVI. Jong S. Cho and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). May 15, 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 2176. 17p.

Colloidal silica dissolved in aqueous suspensions of high surface area thoria was permitted to adsorb on the thoria surface. Silica in three forms was identified by means of infrared spectroscopy, characterized by Si-O vibrational modes in the 9.0 to 10.5 micron region. A band at 9.1μ was attributed to free unadsorbed silica while adsorbed silica resulted in bands of greatest absorbance at 9.4μ or 10.3μ depending upon the character of the surface bonding. Size

considerations, the amount of silica adsorbed, and the character of the infrared spectrum for strongly adsorbed silica was interpreted as evidence of formation of chain or layer silica linkages on the thoria surface. (auth)

28924 (TID-16465) AN INFRARED STUDY OF HYDRATED THORIUM NITRATE. Technical Report No. XVIII. Jong S. Cho and Milton E. Wadsworth (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). May 15, 1962. For Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26, Subcontract 2176. 13p.

Changes were studied in the thorium nitrato frequencies as a result of dehydration over a temperature range in which nitrate decomposition is small. The infrared spectrum of hydrated thorium was characteristic of the coordinated nitrato group and was very similar to $Hg(ONO_2)_2$ which also has volatile nitrato groups. The co-ordinated nitrato group in hydrated thorium nitrate gradually shifted to the ionic nitrate form dependent upon the degree of dehydration at elevated temperatures. No ionic nitrate was in evidence at room temperature. The presence of strong hydrogen bonding between nitrate and lattice water appears to be of importance in distorting the D_{3h} nitrate symmetry to the C_{2v} nitrato symmetry. The removal of water results in a shift from nitrato to nitrate symmetry. The amount of ionic nitrate formed increased for heat treatments to 170°C but decreased abruptly above 170°C, indicating denitration of thorium nitrate. (P.C.H.)

28925 (AEC-tr-4582) JOURNAL OF INORGANIC CHEMISTRY. Translation of Zhurnal Neorganicheskoi Khimii, 1: No. 1, (1956). 208p. (PST-Cat.-571)

28926 (AEC-tr-5202) INVESTIGATIONS OF SUBSTITUTED DITHIOPHOSPHATES. REPORT II. FORMATION OF METAL-DIETHYLDITHIOPHOSPHATES AND THEIR EXTRACTABILITY FROM MINERAL-ACID SOLUTIONS. Helmut Bode and Wolfgang Arnswald. Translated for Oak Ridge National Lab., Tenn. from Z. anal. Chem., 185: 179-201(1962). 57p. (Includes original, 12p.).

The behavior of the elements Cu, Ag, Au, Zn, Cd, Hg, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Se, Te, Mo, W, Re, Ru, Rh, Pd, Os, Ir, and Pt is described during the extraction with CCl_4 in the presence of Na-diethyl-DTP. Investigations were conducted in 0.1–10 N hydrochloric and 0.1–15 N sulfuric acid solutions. The properties of the diethyl-DTP compounds are described on the basis of importance for extractions. The different behavior of the individual elements as well as different valencies of an element indicate the possibility of a larger number of analytical separations. Photometric determinations are possible in many cases. (auth)

28927 (AEC-tr-5258) CHEMICAL TRANSPORT REACTIONS AND THEIR USES. VII. COMMUNICATIONS CONCERNING CHEMICAL TRANSPORT REACTIONS. Harold Schaefer. Translated by H. H. Stone (Oak Ridge National Lab., Tenn.) from Angew. Chem., 73: No. 1, 11-14 (1961). 16p.

Migration of inorganic materials at high temperatures by way of the gas phase from heterogeneous, reversible reactions is discussed. It is shown that chemical transport reactions can be used for the purification of materials for crystal growth, for the preparation of non-stoichiometric compositions of crystalline materials, and as "mineralizator" systems. Information is given concerning the existence of gaseous compounds and their thermodynamic magnitudes in the transport of the materials. It was also found that transport reactions can be used for synthesis by temperature gradients and as intermediates in exchange reactions between solid materials. (M.C.G.)

28928 (AEC-tr-5268) STUDIES ON THE REGULAR LAW OF MASS ACTION. Erich Scheil. Translated by Gretchen R. Riese (Los Alamos Scientific Lab., N. Mex.) from Z. Metallk., 46: 77-83(1955). 20p.

An investigation is described in which theory of regular solutions was used to set up a regular law of mass action. The law was used in determining the shape of the isotherms of equilibria between binary alloys and slag from the two constituents. The shapes of the isotherms associated with this law were calculated on two model examples in which clear deviations from the ideal law of mass action were established. The effects of separation phenomena on the curve forms is discussed. Discussions concerning diluted solutions, tie line representation of the equilibria, and temperature dependence of the equilibria are included. (J.R.D.)

28929 (AEC-tr-5271) INVESTIGATION OF THE LiF–$LiBO_2$ SYSTEM BY THERMOANALYSIS. I. I. Kitaigorodskii, T. A. Popova, and O. K. Botvinkin. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.) from Zhur. Fiz. Khim., 4: 380-2(1933). 4p.

The LiF–$LiBO_2$ system was investigated by thermal analysis. A fusibility diagram was made from the cooling and heating curves. The diagram had one maximum corresponding to the complex compound $2LiF \cdot 3LiBO_2$, which had two polymorphic transformations at 545 and 585°C. The initial substances also had polymorphic transformations: LiF at 812 and 762°C and $LiBO_2$ at 785°C. The eutectic LiF–$2LiF \cdot 3LiBO_2$ had a composition of 67% $LiBO_2$ and a temperature of +688°C. The eutectic $2LiF \cdot 3LiBO_2$ had a composition of about 80% $LiBO_2$ and temperature of +710°C. (auth)

28930 (AEC-tr-5283) INFRARED INVESTIGATIONS OF ISOTOPIC NITROGEN COMPOUNDS. PART 1. THE LOCATION OF THE VALENCE FREQUENCY OF THE -N=N- DOUBLE BOND. R. Kuebler, W. Luettke, and J. Weckherlin. Translated from Z. Elektrochem., 64: 650-18(1960). 17p.

Experiments concerning the detection of N=N valence frequency in the infrared are described. A method of rendering the N=N vibration infrared-active by destroying the symmetry center in trans-azobenzene by monosubstitution ($-N^{14}=N^{15}-$) is discussed. Other possibilities of destroying the symmetry which were investigated include rearrangement of the trans to cis compounds, and substitution on one of the benzene rings of azobenzene or diazoaminobenzene. Observations concerning these studies are included. (J.R.D.)

28931 (AECL-1581) A NEW EXAMINATION OF THE THERMAL CONDUCTIVITY OF HEAVY WATER. H. Ziebland. Translated by G. J. Phillips (Atomic Energy of Canada Ltd., Chalk River, Ont.) from Allgem. Wärmetech., 9: No. 2, 37-9(1959). 9p.

Experimental data for the thermal conductivity of heavy water between 10 and 80°C are reviewed, and a curve of average values, with an estimated accuracy of ±½% is proposed for the temperature range. (auth)

28932 (AECL-1582) THE THERMAL CONDUCTIVITY OF HEAVY WATER. F. Meyer and M. Eigen. Translated by G. J. Phillips (Atomic Energy of Canada Ltd., Chalk River, Ont.) from Z. Naturforsch., 8a: 500-1(1953). 6p.

The thermal conductivity of 95% heavy water was measured between 10 and 60°C, with an estimated accuracy of ±1%, by the column method, using a sample chamber 5 cm long and 3 cm^2 in area. The values were about 3% below those for light water. (auth)

28933 (FTD-TT-61-114) STUDY OF THE MAGNETIC PROPERTIES OF THE YTTRIUM–YTTERBIUM GARNET SYSTEM. Guo-dong Li, Ching-yong Zhai, Hou-wen Xin, and Zhong-rong Chen. Translated from Wu Li Hsueh Pao, 16: 281-8(May 1960). 13p.

The yttrium–ytterbium (Y–Yb) garnet system $Y_{3-x}Yb_xFe_5O_{12}$ where x = 0, 0.75, 1.50, 2.25, and 3.00 was investigated. Samples were prepared by the co-precipitation method and sintered seven hours in oxygen atmosphere at 1350 or 1400°C. Lattice constants and theoretical densities were determined from x-ray diffraction data. It was found that the whole system consisted of a single phase with the garnet structure, and the lattice constant decreased linearly from 12.371 ($Y_3Fe_5O_{12}$) to 12.297 Å ($Yb_3Fe_5O_{12}$). The static hysteresis loop, the initial permeability at 500 kc, the saturation magnetization between liquid-air temperature to the curie point, and the magnetic spectrum between 500 and 3000 mc were observed as a function of compositions. It was found that all the samples had high bulk densities (>90% theoretical densities) and high resistivities (10^9–10^{10} ohm-cm), and the saturation magnetization vs temperature curves had positive slopes at low temperature for $x \geq 1.50$. (auth)

28934 (SCL-T-431) A STUDY OF THE TRANSFORMATIONS OF PHENYL RADICALS IN SOLUTION BY MEANS OF ISOTOPIC AND MASS-SPECTROMETRIC METHODS. I. P. Gragerov and M. Ia. Turkina. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Doklady Akad. Nauk S.S.S.R., 140: 1317-20(1961). 9p.

A method is described for resolving questions concerning homolytic reactions by use of isotopic techniques in combination with mass spectrometry. The method is applicable to homolytic reactions in which compounds containing phenyl groups are involved. The reactions under investigation were carried out in a benzene medium representing a mixture of isotopic varieties of C_6D_6 and C_6H_6 or in a medium of cyclohexanes C_6D_{12} and C_6H_{12}. Results are discussed, and it is noted that the proposed method can be used to indicate reactions with participating free phenyl radicals including the mechanisms involved and is useful in other homolytic processes. (J.R.D.)

28935 (UCRL-Trans-831(L)) THE MECHANISM OF CHEMISORPTION OF GASES ON OXIDES. Karl Hauffe. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Z. Elektrochem., 65: 321-7(1961). 19p.

Kinetic aspects of processes which lead to physical and chemical sorption of gas particles are examined in reactions in which the diffusion voltage is considered as being open. Interest is directed to the formal generalization of the Langmuir adsorption equation for the case of charged particle participation under the assumption immovable "starstellen" (ions at interlattice places, and ion gaps) and of the electronic equilibrium with this condition inside. Interest is also directed to calculation of the experimentally determinable amount of adsorbed gas. Results of CO adsorption on NiO activated with Li_2O and Ga_2O_3 indicate that chemisorption accounts for only a few % of the total absorption. The greatest absorption is produced through surface reaction with the crystal lattice. Other reactions such as H absorption by NiO, and O absorption by ZnO are thought to be similar. (J.R.D.)

28936 ANION-EXCHANGE STUDY. I. ADSORPTION OF SOME ELEMENTS IN HBr-SOLUTIONS. Torkild Andersen and A. Bye Knutsen (Univ. of Aarhus, Denmark). Acta Chem. Scand., 16: 849-54(1962). (In English)

The anion exchange behavior of some elements with 18-electron configuration and of Al, Re, Th, Pa, and U was studied in HBr solutions. Negligible adsorption was shown by Al(III) and Th(IV). Zn(II), Ga(III), Ge(IV), Re(VII), Pa(V), and U(VI) were adsorbed less from HBr solutions than from HCl solutions contrary to Cd(II), Hg(II), In(III), Tl(III), Sn(IV), Pb(II), and Sb(III). Improved separation methods are offered for groups of these elements in comparison to earlier HCl methods. (auth)

28937 ANION-EXCHANGE STUDY. II. THE INDIUM-BROMIDE SYSTEM. Torkild Andersen and A. Bye Knutsen (Univ. of Aarhus, Denmark). Acta Chem. Scand., 16: 875-82(1962). (In English)

The indium-bromide complex system was investigated using the anion-exchange method given by Marcus and Coryell. The mononuclearity of the complexes was tested and confirmed for the range 3×10^{-5} to 3×10^{-4} M indium. The distribution of indium between the resin and the solution was determined in the range 0.1 to 9.3 M LiBr by the batch method using the tracer In^{114}. A corrected distribution function was constructed showing the complexes from $InBr_3^0$ to $InBr_6^{3-}$, with the successive stepwise formation constants: $\log k_2 = 1.3$, $\log k_3 = 0.59$, $\log k_4 = -0.52$, $\log k_5 = -1.6$, and $\log k_6 = -2.2$. The values of k_2 and k_3 agree with published data. (auth)

28938 THE CRYSTAL STRUCTURE OF α-NIOBIUM TETRAIODIDE. Lawrence F. Dahl and Dale L. Wampler (Univ. of Wisconsin, Madison). Acta Cryst., 15: 903-11 (Sept. 10, 1962).

Crystals of α-NbI_4 are orthorhombic, space group $Cmc2_1$, lattice parameters a = 7.67 ± 0.02, b = 13.23 ± 0.02, c = 13.93 ± 0.02 Å, with eight formula units in the unit cell. Final refinement by a three-dimensional anisotropic least-squares analysis resulted in an R value of 8.6%. The structure of solid α-NbI_4 is based on a distorted hexagonal close-packing of the iodine atoms. One-fourth of the available octahedral holes are occupied by niobium atoms to give infinite linear chains formed by NbI_6 octahedra sharing opposite edges. The niobium atoms are shifted from the centers of the octahedra toward one another in pairs to give a resulting Nb–Nb distance of 3.31 Å. Weak metal–metal interactions which couple the unpaired electrons completely explain these niobium shifts and account for the observed diamagnetism of α-NbI_4. The valency state of niobium in α-NbI_4 is concluded to be IV from the observed identical environments of the niobium atoms. α-NbI_4 and the isomorphous TaI_4 are the first simple metal halides which have this structure. (auth)

28939 ENRICHED URANIUM HEXAFLUORIDE. H. Eschnauer. Atomwirtschaft, 7: 357-60(July 1962). (In German)

Technical data on the procurement of nuclear fuels from the USA are given. The physical and chemical properties of UF_6 are described, and the preparation of the enriched fluoride is discussed. The different principles used for the isotopic separation are reviewed. Conversion of UF_6 in both aqueous and nonaqueous media is briefly described. The specifications of the enriched UF_6 supplied by the USA are given in tabular form. (J.S.R.)

28940 NEW POTASSIUM CHLOROURANATES AND URANYL CHLORIDES. Jacques Lucas. Compt. rend., 255: 313-15(July 9, 1962). (In French)

Hydrochloride gas reacts with potassium monouranate and potassium polyuranates. At the conclusion of the reaction potassium uranyl chlorides with the formulas $K_2UO_2Cl_4$, $K_2(UO_2)_2Cl_6$, $K_2(UO_2)_3Cl_8$, and $K_2(UO_2)_4Cl_{10}$ were obtained. The diuranate and triuranate of potassium, with this hy-

drochloric attack, lead intermediately to the chlorouranates $K_2U_2O_3Cl_4$ and $K_2U_3O_3Cl_4$. (tr-auth)

28941 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN SOME S_N1 AND E_2 REACTIONS. S. Ašperger, N. Ilakovac, and D. Pavlović (Ruđer Bošković Inst., Zagreb and Univ. of Zagreb). Croat. Chem. Acta, 34: 7-12(1962). (In English)

The reaction rate of 0.025 M solution of $PhCH_2CD_2Br$ (I) with NaOEt (0.019 M) in anh. EtOH was measured at 59.8°C by extinction at 248 mμ. A k_H/k_D value of 1.17 was found. $k_H/k_D = 1$ was measured potentiometrically for the reaction of 0.05 M solutions of $PhCH_2CD_2SMe_2Br$ (II) and NaOH in H_2O at 79.55°C. With II, about 75% D exchanged during reaction in 2 to 5 M solutions $k_H/k_D = 1.25$ was determined potentiometrically for the hydrolysis of $MeCD_2C(CD_3)_2SMe_2I$ (0.05 M solution) at 59.75°C. The smaller isotope effects in reactions of sulfonium salts vs halides are explained by larger electron transfer in the transition state of the latter reactions. $k_H/k_D > 1$ in the E_2 reaction of I is ascribed to partial rehybridization of C-D bonds in the rate-determining step. (auth)

28942 PRECIPITATION AND HYDROLYSIS OF URANIUM(VI) IN AQUEOUS SOLUTIONS: URANYL NITRATE-POTASSIUM HYDROXIDE-NEUTRAL ELECTROLYTE. B. Tomažić, M. Branica, and B. Težak (Ruđer Bošković Inst., Zagreb and Univ. of Zagreb). Croat. Chem. Acta, 34: 41-50(1962). (In English)

Precipitation of uranium(VI), as measured by turbidity changes from homogeneous solution of 2×10^{-3} N uranyl and equivalent concentration of potassium hydroxide, was achieved by addition of neutral ions K, Ca, Sr, Ba, Y, and La as nitrates. At pH 5 to 6, at which the original solutions remain clear, addition of increasing concentration of these ions causes increased precipitation of U, up to 70% of the total, as limit. Further addition has no influence. The higher the valency of the cation added, the lower is the critical concentration required for precipitation but there is no quantitative dependence according to the Schulze-Hardy rule. Specific influence of cations is pronounced. Differences in the critical precipitation concentration are larger between, e.g., Sr^{2+} and Ba^{2+} than between Ba^{2+} and Y^{3+}. The phenomena are restricted to limited concentration regions of which the 2×10^{-3} N concentration of U was found as representative. The precipitation of U is represented as the combined effect of hydrolysis, of formation of mixed uranates of K, and the added precipitation cation, and of coprecipitation. (auth)

28943 REDUCTION OF ZINC OXIDE BY CARBON MONOXIDE IN THE PRESENCE OF STRONTIUM OXIDE. Thomas Stuart Jones (Pennsylvania State Univ., University Park). Dissertation Abstr., 23: 191-2(July 1962).

The kinetics of reduction of ZnO by CO in the absence and presence of SrO are compared. The effects of SrO on the acceleration of reduction by CO were studied, along with the kinetics of carbonation of SrO according to the reaction, $SrO + CO_2 = SrCO_3$. The carbonation of approximately 0.56 gm samples of SrO was studied over the range of temperatures, 500 to 850°C, at atmospheric pressure. The concentration of CO_2 in the gas used for carbonation was varied from 100 down to 1.4% through the use of either pure CO_2 or of N_2-CO_2 mixtures of controlled composition. Reduction was significantly more rapid in the mixture containing SrO than in the $SrCO_3$-ZnO control. The relative rates of reduction were estimated to be 11:1 at 750°C and 5.9:1 at 677°C. The CO_2 liberated by the reduction of the ZnO was quantitatively absorbed when SrO was present. The increase in reduction rate with SrO was attributed to the complete removal of one of the gaseous products within the confines of the sample. The carbonation of SrO was observed to take place in two stages, the first of which was much faster than the second. The slow stage was most pronounced at lower temperatures with intermediate values of P_{CO_2}. The rates of both stages were virtually independent of temperature. The rate of the initial stage was directly proportional to P_{CO_2} when P_{CO_2} was less than 0.2 atm. The results are thought to indicate that the course of carbonation was controlled by gaseous diffusion processes in the gas phase enveloping the sample and in the pores of the reacting solid.

28944 STABILITY CONSTANTS OF MONONUCLEAR PHOSPHATE COMPLEXES OF STRONTIUM. H. Gnepf, O. Guebeli, and G. Schwarzenbach (Technische Hochschule, Zurich). Helv. Chim. Acta, 45: 1171-83(1962). (In German)

The complex formation in homogeneous solution of Sr^{2+} with various phosphates was investigated by Schubert's ion exchange method. The total concentration of the metal was 10^{-6} M and Sr^{89} served as tracer. Stability constants of the following mononuclear species are given: $SrPO_4^-$, $SrHPO_4$, $SrH_2PO_4^+$, $SrP_2O_7^{2-}$, $SrP_3O_{10}^{3-}$, $SrHP_3O_{10}^{2-}$, $SrP_3O_9^-$, and $SrP_4O_{12}^{2-}$. (auth)

28945 PHASE RATIOS IN $Y_2O_3-ZrO_2$. I. FORMATION OF YTTRIUM ZIRCONATE AND PHYSICO-CHEMICAL PROPERTIES. Fu-chang Fang, A. K. Kuznetsov, and E. K. Kiler (Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Otdel. Khim. Nauk, No. 7, 1141-6(July 1962). (In Russian)

The constitution diagram of $Y_2O_3-ZrO_2$ was studied and $Y_2Zr_2O_7$ compounds were found. Conditions for yttrium zirconates preparation are analyzed and physico-chemical and technical properties are determined. (R.V.J.)

28946 SOLUBILITY OF $KF-ZrF_4-H_2O$ AT 20°C. V. G. Bamburov, N. V. Demenev, and V. M. Polyakova (Academy of Sciences, Ural Department, Sverdlovsk, USSR). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 5, 70-5(1962). (In Russian)

Three phases; $KZrF_5$, K_2ZrF_6, and K_3ZrF_7; were observed in $KF-ZrF_4-H_2O$ systems expanded by KF additions. The $KZrF_5$ and K_2ZrF_6 dissolve in water, while K_3ZrF_7 is unstable and recrystallizes into K_2ZrF_6. The solubilities of complex zirconium fluorides in water were determined at 20°C. (R.V.J.)

28947 THE RELATIVE IMPORTANCE OF C-H BOND ENERGY AND ALKYL INTERFERENCE IN RECOIL TRITIUM REACTIONS WITH ALKANES. John W. Root and F. S. Rowland (Univ. of Kansas, Lawrence and Max-Planck-Institut fur Chemie, Mainz). J. Am. Chem. Soc., 84: 3027-8(Aug. 5, 1962).

Hot recoil tritium atoms react with alkanes according to the reactions (1) $T^* + RH \rightarrow HT + R\cdot$ and (2) $T^* + RH \rightarrow H\cdot$. An increase in the branching of RH increases the HT/RT yield ratio. A test was made to ascertain whether alkyl substituents on RH was hindering reaction (2) or facilitating reaction (1). Competitive recoil tritium reactions were carried out in $CH_4-C_4H_{10}$ mixtures, and the relative yields of CH_3T and C_4H_9T were measured. The C_4H_9T/CH_3T ratio fell in the range 2.3 to 2.6, agreeing with the ratio of H atoms per molecule (2.5). It is concluded that the average probability of T for H substitution per H atom is closely comparable in CH_4 and C_4H_{10}, that the HT/RT yield ratio variations are due to increases in the frequency of reaction (1) with increasing alkyl substitution, and that hot H abstraction is sensitive to C-H bond energy differences. (D.L.C.)

28948 METAL CHELATES OF ADENOSINEDIPHOSPHORIC AND ADENOSINEMONOPHOSPHORIC ACIDS. M. M. Taqui Khan and A. E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc., 84: 3037-41(Aug. 20, 1962).

Stability constants of the 1:1 chelates of ADP and of adenosine-3- and 5-phosphoric acids with divalent metal ions, Cu(II), Ni(II), Co(II), Mn(II), Zn(II), Mg(II), Ca(II), Sr(II), and Ba(II) are reported at 25°C and 0.1 ionic strength. The stabilities increase in the sequence: Ba < Sr < Ca < Mg < Mn < Co < Zn < Ni < Cu. The first and second hydrolysis constants, and the dimerization constant of the copper(II)-ADP and of the zinc(II)-ADP chelates, are reported. (auth)

28949 INFLUENCE OF METAL IONS AND OF METAL COMPLEXES ON THE HYDROLYSIS OF SALICYL PHOSPHATE. Robert Hofstetter, Yukito Murakami, George Mont, and Arthur E. Martell (Clark Univ., Worcester, Mass.). J. Am. Chem. Soc., 84: 3041-6(Aug. 20, 1962).

The first order hydrolysis of salicyl phosphate was studied at 30.3°C at 0.10 M ionic strength in the presence of, and in the absence of, various salts and metal chelate compounds. The order of increasing catalytic activity for metal salts is Cu(II) < UO_2(VI) < VO(IV) < ZrO(IV), Fe(III), while salts of Ni(II), Co(II), Zn(II), and Cd(II) were found to be inactive. In general it was found that the reaction rates in the presence of metal chelates are considerably lower than the rates for the corresponding aquo metal ions. In the absence of metal ions, the variation of rate of hydrolysis with hydrogen ion concentration shows first order dependence on the individual ionic species of the substrate. (auth)

28950 THE MECHANISM OF RECOIL TRITIUM REACTIONS WITH HYDROCARBONS IN THE LIQUID PHASE. Edward K. C. Lee and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc., 84: 3085-90 (Aug. 20, 1962).

The distribution of recoil tritium atoms among various molecular species after reaction with trans-hexene-2 or trans-butene-2 is quite similar for reactions carried out in gas and liquid phases. The principal differences are observed for those olefinic products (propylene, butene-1, pentene-1) which are formed primarily through decomposition of an excited free radical. The liquid phase yields for these are lower by factors of 2.5 to 8, consistent with more rapid collisional deëxcitation of the excited radical. The energetic reactions of the tritium atom itself are essentially the same in both the gaseous and liquid phases. (auth)

28951 ABSORPTION SPECTRUM OF YTTERBIUM IN SINGLE CRYSTAL OF CALCIUM FLUORIDE. W. Low (National Research Council, Ottawa and Hebrew Univ., Jerusalem). J. Chem. Phys., 37: 30-3(July 1, 1962).

High-resolution spectrum of Yb^{3+} in the cubic field of CaF_2 is reported. The striking features of the spectrum are two strong sharp lines at 10 384.759 and 10 377.039 cm^{-1} at 4.2°K. The position of the two lines and their separation was measured as a function of the temperature. The line shape is Lorentzian. The possible position of the various Stark levels of the ground state is discussed. (auth)

28952 SOLUBILITY OF HELIUM IN LIQUID HYDROGEN. Leonard O. Roellig (Wayne State Univ., Detroit) and Clayton Giese. J. Chem. Phys., 37: 114-16(July 1, 1962).

The solubility of helium in liquid hydrogen was measured as a function of temperature and pressure. It was found that the solubility varied from 0.59 mole % for T = 26.8°K and 1.98 atm partial pressure of helium to 11.1 mole % for T = 19.8°K and 7.0 atm partial pressure of helium. (auth)

28953 EXCESS FREE ENERGIES AND HEATS OF MIXING IN CERTAIN MOLTEN SALT MIXTURES. Milton Blander (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 37: 172-3(July 1, 1962).

The third- and fourth-order terms of the perturbation theory of Reiss, Katz, and Kleppa for the excess free energies and heats of mixing of molten salts were calculated for a particular choice of "test salt." Up to the fourth order, the expressions have the form $X_1X_2P\delta^2 + X_1X_2(X_1 - X_2)Q\delta^3 + (X_1X_2R + X_1X_2(X_1 - X_2)^2S)\delta^4 + \ldots$, which is consistent with and rigorously justifies the concentration dependence of the observed heats of mixing of alkali nitrates. The equations can be derived for salts having a much more general cation-anion interaction potential than was stated by Reiss, Katz, and Kleppa. (auth)

28954 EFFECT OF UNIAXIAL STRESS ON THE SPECTRUM OF $CaF_2(Sm^{2+})$. W. A. Runciman and C. V. Stager (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 37: 196-7(July 1, 1962).

A pressure effect on the energy levels of $CaF_2(Sm^{2+})$ was observed; the absorption line undergoes a large strain splitting, and the fluorescent line shifts considerably to lower energies. The relative effects of pressure applied along the main crystallographic directions are discussed. The results indicate an unshielded d electron in the upper level. (D.L.C.)

28955 FREQUENCY DISTRIBUTION OF HEXAMETHYLENETETRAMINE CRYSTALS. L. N. Becka (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Chem. Phys., 37: 431-2(July 15, 1962).

The energy distribution of neutrons inelastically scattered from hexamethylenetetramine powder at 80 and 300°K is given. Features of the scattering curve are described and interpreted in the light of a simple model of the lattice vibration spectrum. (auth)

28956 QUANTUM-MECHANICAL TRANSITION-COMPLEX THEORY OF REARRANGEMENT COLLISIONS. Walter R. Thorson (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 37: 433-45(July 15, 1962).

The theory of rearrangement collisions is discussed in applications to bimolecular chemical reactions, using the method of stationary-state solutions to the Schrödinger equation to avoid the perplexities associated with the nonorthogonality of initial and final states. The analysis employed is orginially due to Gerjuoy [E. Gerjuay, Phys. Rev. 109: 1806(1958); Ann. Phys. (N.Y.) 5: 58(1958)]. The usual results of the formal theory of scattering, involving the transition matrix element, are derived, and a further explicit development of the theory is given which permits the use of a model Hamiltonian to represent the reacting system. Several alternate expressions are obtained for the transition matrix element, involving the use of the "transition complex" eigenfunctions as an approximate basis for expansion of the state vector; and an approximate expansion in ascending orders of "virtual reactive scatterings" is introduced as a method for rapidly expanding the state vector. (auth)

28957 DETERMINATION OF THE NORMAL POTENTIAL OF THE Pa^{IV}/Pa^{V} COUPLE. Moïse Haïssinsky and Elisabeth Pluchet (Laboratoire Curie, Paris). J. chim. phys., 59: 608-10(June 1962). (In French)

By partial reduction of Pa^{5+} in extremely dilute solution ($\sim 10^{-10}$ M) into Pa^{4+} with $Cr^{2+} + Cr^{3+}$ or $V^{2+} + V^{3+}$ in variable proportion of the two ions in each of these mixtures, the electrochemical potential of the Pa^{IV}/Pa^{V} couple in 6N

HCl solution was determined to be E = −0.29 ± 0.03 v. The discussion of the probable ionic forms of Pa^{4+} and Pa^{5+} in 6N and normal HCl solution leads to the conclusion that the apparent normal potential of the couple is $E'_0 \simeq 0.25$ v. (tr-auth)

28958 PRESSURE-TEMPERATURE-COMPOSITION RELATIONSHIPS OF THE YTTRIUM–HYDROGEN SYSTEM. C. E. Lundin and J. P. Blackledge (Univ. of Denver). J. Electrochem. Soc., 109: 838-42(Sept. 1962).

Pressure-temperature-composition studies of the yttrium–hydrogen system were made in the temperature range 900 to 1350°C and the pressure range 1 to 760 mm Hg. The existence of a yttrium-solid-solution phase and a yttrium-hydride phase, which approaches YH_2 in composition, was established. These phases occur over a range of composition and are separated by a two-phase region at intermediate hydrogen compositions. The calculated heat of reaction of the dihydride phase from the saturated solid solution is ΔH = −44.42 ± 0.40 kcal/mole H_2, and the entropy of reaction is ΔS = −27.07 ± 0.30 cal/mole H_2-degree. Partial molal heats and entropies of solution of hydrogen in the single phases are also presented. The nature of the solubility relationships in the yttrium–hydrogen system below 900°C was studied at atmospheric pressure. The existence of a stable trihydride phase was established below approximately 300°C and 1 atm pressure. The solubility relationships of the yttrium–hydrogen system were developed from the pressure-temperature-composition relationships and from x-ray-diffraction analysis and metallographic examination. X-ray-diffraction structural analysis of yttrium metal, the dihydride and trihydride phases gave the following structures and x-ray densities:

Yttrium metal	YH_2	YH_3
Hexagonal close-packed	Face-centered cubic	Hexagonal
a_0 = 5.750 ± 0.001Å	a_0 = 5.201 ± 0.001Å	a_0 = 3.674 ± 0.001
c_0 = 3.654 ± 0.001Å	ρ = 4.293 g/cc	c_0 = 6.599 ± 0.001Å
ρ = 4.440 g/cc		ρ = 3.958 g/cc

(auth)

28959 KINETIC STUDIES ON SLOW COAGULATION OF THORIUM OXIDE SOL. B. N. Ghosh and S. Bandyopadhyay (Univ. Colleges of Science and Tech., Calcutta). J. Indian Chem. Soc., 39: 309-13(May 1962). (In English)

A modified form of Smoluchowski's slow coagulation equation proposed by Ghosh was verified experimentally for ThO_2 sol. The spectrophotometric technique followed has been developed by Mukherjee. The rate of coagulation of ThO_2 sol was found to be higher with KNO_3 than with KCl as coagulant. The autocatalytic nature, absent with well-dialyzed sol, gradually appears on addition of co-ions. Appearance of S-shape was explained from a new point of view. Suitable explanation for the constants α, β (or a and b) in the kinetic equation is yet to be advanced. (auth)

28960 LIQUID AMINE AND ION-EXCHANGE RESIN ABSORPTION OF BROMIDE ION FROM AQUEOUS SALT SOLUTIONS; VARIATION WITH AQUEOUS ELECTROLYTE ACTIVITIES. S. Lindenbaum and G. E. Boyd (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 66: 1383-7(Aug. 1962).

The absorption of microquantities of bromide ion from aqueous solutions of hydrochloric acid, lithium, sodium, potassium, and cesium chlorides by tri-n-octylamine solutions in toluene, and from hydrochloric acid by a strong-base anion exchanger, was measured. The departure of the equilibrium distribution coefficients for the liquid ion exchanger from a "mass law" dependence on electrolyte concentration could be explained quantitatively by the non-ideality of the aqueous phase except for the concentrated hydrochloric acid solutions. With the anion-exchange resin, however, corrections for aqueous phase non-ideality and for de-swelling were not sufficient to cause the distribution data to conform to the mass law; in addition, an important correction for the organic phase non-ideality was required. The magnitude of the organic phase non-ideality could be correlated with the invasion of this phase by electrolyte. When the invasion was small, or absent, as with the liquid exchanger, the non-ideality was small and could be neglected. (auth)

28961 THE RELATIVE VOLATILITIES OF THE SYSTEM $H_2O^{17}–H_2O^{16}$. J. L. Borowitz (Israel Atomic Energy Commission, Rehovoth and Weizmann Inst. of Science, Rehovoth, Israel). J. Phys. Chem., 66: 1412-14(Aug. 1962).

The relative volatility of the system $H_2O^{17}–H_2O^{16}$ was determined at absolute pressures of 100 and 260 mm. The experiments were carried out in a distillation column with production. (auth)

28962 HYDROGEN EXCHANGE IN BENZYL MERCAPTAN STUDIED BY NUCLEAR MAGNETIC RESONANCE. M. Sheinblatt and Z. Luz (Weizmann Inst. of Science, Rehovoth, Israel). J. Phys. Chem., 66: 1535-6(Aug. 1962).

A nuclear magnetic resonance (nmr) study was made of the hydrogen exchange in acidic and basic solutions of benzyl mercaptan. The results for acidic solutions can be explained in terms of the reaction $C_6H_5CH_2SH_2^+ + C_6H_5CH_2SH \rightarrow C_6H_5CH_2SH + C_6H_5CH_2SH_2^+$, where the rate constant is 1.35×10^3 $M^{-1}sec^{-1}$. For basic solutions, no change in the nmr spectra was found until the base concentrations exceeded 1.2×10^{-3} M, which could be attributed to acidic impurities in the original benzyl mercaptan. The rate constant for the reaction in basic solution $C_6H_5CH_2S^- + C_6H_5CH_2SH \rightarrow C_6H_5CH_2SH + C_6H_5CH_2S^-$ was determined to be $\sim 6 \times 10^5$ $M^{-1}sec^{-1}$. (D.L.C.)

28963 FREE ENERGY OF FORMATION OF MOLYBDENUM OXIDE AND CARBIDE. Molly Gleiser and John Chipman (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem., 66: 1539-40(Aug. 1962).

The free energies of formation of MoO_2 and nonstoichiometric Mo_2C were determined by equilibrium pressure measurements over the $MoO_2–Mo_2C–Mo$ system. For MoO_2 at 1200 to 1350°K, ΔF_f° = −137,890 + 40.18T cal/mole, and the heat of formation at 298.15°K is −141.5 kcal/mole. For nonstoichiometric Mo_2C at 1200 to 1340°K, ΔF_f° = −11,710 − 1.83T cal/mole, and the heat of formation is ~−11.7 kcal. (D.L.C.)

28964 BINDING ENERGIES OF THE GASEOUS ALKALINE EARTH HALIDES. Thomas E. Brackett and Elizabeth B. Brackett (William Marsh Rice Univ., Houston, Tex.). J. Phys. Chem., 66: 1542-3(Aug. 1962).

The binding energies of gaseous alkaline earth halides were calculated with a repulsion energy term $Ae^{-r/\rho}$, where ρ = 0.27 A for all the halides. The calculated values are compared with recently revised experimental values and values calculated by Cubicciotti, using $Ae^{-r/\rho}$ and Ar^{-n} as the repulsion energy term. The agreement is satisfactory, except for the beryllium halides. The differences between the calculation method and that of Cubicciotti are discussed. (D.L.C.)

28965 HEAT OF REACTION OF FLUORINE WITH GRAPHITE. Richard F. Porter and David H. Smith (Cornell Univ., Ithaca, N. Y.). J. Phys. Chem., 66: 1562-3(Aug. 1962).

A study was made of the reactions of CF_3-CCl_3(g) and CF_2Cl-$CFCl_2$(g) with graphite in order to determine the heat of reaction of F_2(g) with graphite. The results show

that the reactions are CF_3-CCl_3(g) + graphite → CF_2 = CCl_2(g) + (F + Cl) graphite (ΔH^0 = 18.7 ± 2.0 kcal/mole) and CF_2Cl-$CFCl_2$(g) + graphite → CF_2 = CFCl(g) + 2Cl(graphite) (ΔH^0 = 10.5 ± 1.5 kcal/mole). Thermochemical considerations give ΔH^0 = −100.2 ± 6 kcal/mole for F_2(g) + graphite → 2F(graphite). It is pointed out that the reaction of CF_3-CCl_3(g) with graphite probably involves bonding of F to active surface sites. (D.L.C.)

28966 AN ISOTOPE EFFECT IN THE PROBABILITY OF IONIZING A MOLECULE BY ENERGY TRANSFER FROM A METASTABLE NOBLE-GAS ATOM. William P. Jesse (St. Procopius Coll., Lisle, Ill.) and Robert L. Platzman. Nature, 195: 790-1(Aug. 25, 1962).

In experiments on the isotope effect, ionization currents produced by β rays (mean kinetic energy about 18 kev) from a source of Ni^{63} deposited on a gridded electrode were determined in an ionization chamber for normal and fully deuterated ethylene and n-butane both in neon and in argon. Curves for the deuterated hydrocarbons were consistently higher than for the corresponding normal hydrocarbon by the order of magnitude of 1%, about ten times the estimated error of measurement. In the plateau region the ratio of the ionization currents, ($N_i = \Delta N_i^D$)/($N_i = \Delta N_i^H$), was found to be independent of contaminant concentration. The calculated isotope effects were of the same order of magnitude as those observed; comparison points to symmetrical splitting with Ar^+ ($\bar{E}$ = 11.6 ev), and dissociation of H (or of H_2) with Ne^+ ($\bar{E}$ = 16.7 ev). It is suggested that with Ne^+, but not with Ar^+, there is much ample energy to dissociate an excited hydrogen atom. (P.C.H.)

28967 ABSORPTION SPECTRA OF NEODYMIUM CHLORIDE IN ALCOHOL-WATER SOLUTIONS AT LOW TEMPERATURES. I. S. Pominov. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 357(May 1962).

Solutions of anhydrous $NdCl_3$ in anhydrous C_2H_5OH were cooled to temperatures from −180 to +20°C and their absorption spectra photographed in the region of the alcohol absorption peak at 4296 Å. On lowering of the temperature to −180°C, the 4296 Å peak is shifted 3 Å to the blue with increased absorption and a peak appears at 4272 Å at ≤−87°C. The 4272 Å peak can be produced at higher temperatures by adding water and the 4296 Å peak at −180°C disappears when 4 molecules water per $NdCl_3$ molecule is added. The spectral changes can be explained by displacement of the alcohol molecules with water in the solvate sheath of the Nd^{3+} ion when the temperature is lowered. The presence of water in the solutions is probably due to incomplete dehydration of the alcohol and/or absorption of water vapor from the air. (D.L.C.)

28968 EXPERIMENTAL MEASUREMENTS OF ENTHALPY, TEMPERATURE AND HEAT OF MELTING OF α-MODIFICATION Al_2O_3 IN THE RANGE FROM 1200 TO 2500°K. P. B. Kantor, L. S. Lazareva, V. V. Kandyba, and E. N. Fomichev. Ukrain. Fiz. Zhur., 7: 205-11(1962). (In Ukrainian)

The results of heat capacity and enthalpy measurements of aluminium oxide (corundum) in the range of 1005 to 2476°K are described as well as the temperature and heat of phase transition. The measurements were carried out in a high temperature vacuum furnace in a massive isothermal calorimeter. The temperature of the container in the high vacuum furnace during the heating was measured by means of a high-precision optical pyrometer «OII-5.1M with an accuracy of ±2°C. The measurements of the temperature rise in the calorimeter were made after dropping the container into the calorimeter by means of a platinum resistance thermometer and a special thermometric bridge with an accuracy of 0.001°C. To carry out measurements of the enthalpy of corundum in a liquid state, the sample was placed into a hermetically sealed container of special design made from a molybdenum bar. The enthalpy and heat capacity of Al_2O_3 in the solid and liquid state were found from the experimental data given in the table. The melting point of Al_2O_3 was found to be 2315 ± 4°K, the heat of melting 28.30 ± 0.55 kcal/mole. (auth)

28969 ORGANIC COMPOUNDS OF BERYLLIUM, CALCIUM, STRONTIUM, AND BARIUM. G. A. Balueva and S. I. Ioffe (Inst. of Elemento-organic Compounds, Academy of Sciences, USSR). Uspekhi Khim., 31: 940-62(Aug. 1962). (In Russian)

A review is given of the physical and chemical properties of Be, Ca, Sr, and Ba organic compounds. The electro-positive compound of Ca, Sr, and Ba are similar to Li and Na in their ability to join with ethylene bonds, however, their reactivity is weaker. Beryllium organic compounds are quite similar to magnesium in their covalent structure and relative reactivity. (R.V.J.)

28970 ELECTRIC CONDUCTIVITY OF URANIUM OXIDES IN HYDROGEN CURRENT. V. N. Strekalovskii, A. D. Neuiman, and A. F. Bessonov (Inst. of Electrochemistry, Academy of Sciences, Ural Branch, USSR). Zhur. Fiz. Khim., 36: 1355-8(June 1962). (In Russian)

The variability of UO_3 electric conductivity during reduction by hydrogen is used as an example in indicating the feasibility of applying resistance measurements in studies of solid-gas reduction processes. (R.V.J.)

28971 THERMODYNAMIC PROPERTIES OF PRASEODYMIUM OXIDES. F. A. Kuznetsov and T. N. Rezukhina (Moscow State Univ.). Zhur. Fiz. Khim., 36: 1364-7(June 1962). (In Russian)

The heat capacity of Pr_2O_3 at 298 to 1200°K was measured in a large calorimeter. The true heat capacity as a function of the temperature is described by the equation $Cp = 23.76 + 1.25 \times 10^{-2}$ T cal/grad mole. Thermodynamic functions for Pr_2O_3 and Pr_6O_{11} at 298 to 1200°K were calculated. (R.V.J.)

28972 NEUTRON DIFFRACTION STUDIES OF HIGH-TEMPERATURE BERYLLIUM OXIDES. I. M. Kuleshov, G. G. Sadikov, and Z. A. Sokolov (Inst. of Applied Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 36: 1369-71(June 1962). (In Russian)

Neutron and x-ray diffraction analyses were made of the crystal lattice of beryllium oxide annealed at 2000°C. Neutron diffraction data confirmed x-ray data on the Be atom position in the lattice. Neutron data indicated the magnitude of the temperature constant B = 0.92 and the Debye temperature Θ = 602 ± 13°K. (R.V.J.)

28973 ION EXCHANGE SORPTION OF RADIOELEMENTS BY SOILS. IV. COMPLEX FORMATION OF CERTAIN METAL IONS WITH HUMIC ACID. E. A. Chuveleva, P. P. Nazarov, and K. V. Chmutov (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Fiz. Khim., 36: 1378-81(June 1962). (In Russian)

The bonding of Y, Pm, and Ca in humic acid solutions was studied. Humic acid forms complex compounds with rare earth and alkali ions. The stability constants were determined for the Y, Pm, and Ca complexes. (R.V.J.)

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Refer also to abstract 29207.

28974 (IA-738) THE RETENTION OF F^{18}, PRODUCED BY THE F^{19}(n,2n) REACTION, IN FLUOROOR-

GANIC COMPOUNDS. M. Anbar (Israel. Atomic Energy Commission, Tel Aviv and Weizmann Inst. of Science, Rehovoth, Israel) and P. Neta (Israel. Atomic Energy Commission, Tel Aviv). June 1962. 31p.

Fluoroörganic compounds were irradiated by fast neutrons from a nuclear reactor; fluoroderivatives labeled with F^{18} were produced and their yield was determined. It was found that labeling yields of fluoroörganic compounds were substantially higher than those of other organic compounds exposed to F^{18} produced extramolecularly, either by the $O^{16}(H^3,n)$ or the $F^{19}(n,2n)$ reactions. The extent of substitution of a hydrogen atom by radiofluorine was found to be more than one hundred times that of substitution of a fluorine atom. It was shown that the labeling occurs in the same part of the molecule which originally carried the fluorine atom; most probably the same atom is transformed to a radionuclide. (auth)

28975 (NP-12015) MOLECULAR STRUCTURE AND PHYSICAL BEHAVIOR OF POLYMERS. Progress Report No. 8, May 1, 1962–July 31, 1962. Maurice Morton and A. N. Gent (Akron, Ohio. Univ. Inst. of Rubber Research). Aug. 23, 1962. Contract AF33(616)-6965. 19p.

Crosslinked polyethylene films were prepared by gamma irradiation of molten linear polyethylene in vacuo. Various degrees of orientation were imposed by stretching test-pieces to fixed lengths in the molten state. The dependence of the tensile stress upon temperature was then determined over the temperature range 150 to 110°C. The tensile stress at constant length decreased markedly as crystallization developed. The temperature of incipient crystallization, marked by the onset of the stress reduction, increased with the imposed extension. At a lower temperature, which did not depend significantly on the degree of extension, the tensile stress began to rise sharply with further cooling. This is attributed to the growth of folded chain crystals. Studies were also made on the isomerization reactions of polystyryl lithium in benzene solution. It was found that, after several hours at 75°C, an amount of lithium hydride was formed corresponding to 50% of the original organolithium content. This agrees with the mechanism proposed for the case of polystyryl sodium in tetrahydrofuran. (auth)

28976 (NYO-10177) DEVELOPMENT OF TRITIUM LABELING OF ORGANIC MATERIALS. Quarterly Technical Status Report No. 1, March 1, 1962–May 31, 1962. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). July 1, 1962. Contract AT(30-1)-2976. 23p.

Studies were made on the applicability range of tritium labeling with a new tritiating reagent. Data are given which outline the potential types of organic structures susceptible to labeling by the $TH_2PO_4 \cdot BF_3$ reagent. Structures which inhibit the labeling reaction, as well as those which enhance it, are described. There are certain limitations in the application of the method, since some compound types tend to be unstable in the presence of the acidic reagent. These types are outlined. Methods developed for successfully tagging unstable compounds with a minimum formation of by-products are described. Comparative data are given on tagging with tritiated phosphoric acid and the corresponding BF_3 complex. (auth)

28977 (NYO-10360) A STUDY OF THE EFFECT OF RADIATION ON BIOLUMINESCENT MATERIALS. Final Report. Howard H. Seliger and W. D. McElroy (Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.). Aug. 9, 1962. Contract AT(30-1)-2189. 9p.

Research progress is reported on the quantum yields of bioluminescence and chemiluminescence and the role of oxygen in biological oxidations. The luminal light reaction was examined as a means of establishing the mechanism for the firefly and bacterial bioluminescence. It was found that immediately after the light reaction the product fluorescence is identical with the chemiluninescence and is quenched strongly by the slightest trace of water. The quantum yield was dependent on the nature of the catalyst used to decompose H_2O_2. Experimental conditions were determined for the measurement of the quantum yeild of in vitro bacterial bioluminescence. Firefly ludiferin and oxyludiferin were synthesized. The chemiluminescence of firefly luciferin was observed in both the organic solvent dimethyl sulfoxide and aqueous solution. An investigation of the effects of light on contraction of the iris sphineter of the European eel and frog. A mechanism was postulated for the role of bioluminescence in evolution. (M.C.G.)

28978 (RRL-39) EVIDENCE FOR RADICAL ISOMERIZATION DURING RADIOLYSIS. Richard [A.] Holroyd (Mellon Inst. Radiation Research Labs., Pittsburgh). May 24, 1960. Contract AT(30-1)-2310. 4p. (NYO-9158)

Radical isomerization during the radiolysis of neopentane is evidenced by the formation of octane and nonane products. Five major products were identified by comparison of retention times and mass spectral patterns with authentic samples. The radicals were formed presumably as a direct result of ionization. (N.W.R.)

28979 (TID-12303) ELECTRON SPIN RESONANCE IN NEUTRON IRRADIATED QUARTZ. Robert H. Silsbee (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Mar. 19, 1961. Contract AT(30-1)-2150. 14p.

The electron spin resonance spectrum of one of the defects produced by fast neutron irradiation of crystalline quartz was analyzed. The g-tensor and the tensors describing the hyperfine interaction of the defect electron with three of the silicon atoms associated with the center were deduced. Some applications of these results are discussed. (auth)

28980 (TID-16424) A DETERMINATION OF LOW ENERGY MASS ATTENUATION COEFFICIENTS OF OXYGEN AND NITROGEN (thesis). Orland James Gant, Jr. (Vanderbilt Univ., Nashville). June 1962. 47p.

The mass attenuation coefficients of oxygen and nitrogen were measured in integral kev units from 6 to 12 inclusive with the probable error of individual measurements being less than or equal to 5.4%. For this wave length range (1.033 to 2.066 Å), the results of the measurements indicated that the λ^3 equation was a good first approximation. The main source of error detected was lack of regulation of voltage supplied to the x-ray tube filament causing a small variation with time in the intensity. Other known sources of error were either eliminated or reduced to a negligible factor. The experiment was limited to a maximum energy of 12 kev that could be investigated by the design of the gas cell, and to a minimum energy of 6 kev by output of the x-ray tube. (auth)

28981 (UCRL-10053) THE RADIATION CHEMISTRY OF NUCLEIC ACID CONSTITUENTS (thesis). Cyril Andrew Ponnamperuma (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1962. Contract W-7405-eng-48. 125p.

The chemical effect of ionizing radiation on nucleic acid constituents was studied with the intention of finding the effects which may be of significance in understanding the origin of a radiation mutation. C^{14}-labeled purine and pyrimidine bases, nucleosides, and nucleotides were irradiated in

aqueous solution in the absence of oxygen. The radiation decomposition products were analyzed by paper chromatography, uv absorption spectrophotometry, and liquid scintillation counting. Several reactions mediated by the free radicals produced by the radiolysis of water were investigated. The G values for bases, nucleosides, and nucleotides destroyed were approximately of the same order. Guanine, however, was anomalous in its behavior. As the free base, guanine appeared to be far more resistant to radiation than guanosine or guanylic acid. Of special significance is the deamination of amino bases to hydroxy bases. The G values for the reactions were small (0.1 or less), but it is believed that the occurrence of such reactions in the radiolysis of nucleic and constituents might suggest a possible explanation for the origin of a radiation mutation. (auth)

28982 (UCRL-10360) CHEMICAL EFFECTS FOLLOWING THE $S^{34}(n,\gamma)S^{35}$ REACTION IN GASEOUS SULFUR COMPOUNDS (thesis). Monte Lee Hyder (California. Univ., Berkeley. Lawrence Radiation Lab.). July 11, 1962. Contract W-7405-eng-48. 60p.

The chemical behavior of S^{35} formed by $S^{34}(n,\gamma)$ was studied in gaseous H_2S, SO_2, SF_6, CH_3SH, and thiophene. The reaction was carried out by sealing the gases in quartz ampules and irradiating them with thermal neutrons in the LPTR reactor. Among the effects studied were those of pressure, surface area, and additive gases including argon, nitric oxide, oxygen, and hydrogen. S^{35} was recovered both in gaseous compounds and in deposits on the walls of the ampules; the chemical compositions of both portions of activity were determined by carrier techniques and aqueous chemistry. The results support a model in which the original molecule is broken up in the recoil process and the resulting fragments containing S^{35} react with the surroundings only after they have slowed to thermal energies; in general the final chemical form of the S^{35} is determined by the chemical environment in which the S^{35} is produced rather than by its original oxidation state or chemical form. An exception to this was the results obtained with added nitric oxide, which suggest that the original molecule may not be completely broken up in all cases. (auth)

28983 (AEC-tr-4578) RADIOCHEMISTRY. Translation of Radiokhimiya, 2: Nos. 5-6, (1960). 253p. (PST-Cat.-569-570)

28984 (AEC-tr-5229) GENERAL RULES GOVERNING THERMODYNAMIC ISOTOPE EFFECTS IN TRITIUM-PROTIUM EXCHANGE. Ya. M. Varshavskii. Translated from p.170-7 of "Proceedings of a Symposium on Tritium in the Physical and Biological Sciences, held in Vienna, May 3-10, 1961. Vol. I" (a publication of the International Atomic Energy Agency, Vienna, 1962). (STI/PUB/39(Vol.I(p.170-7))). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 16088.

28985 (FTD-TT-62-982) A REACTOR FOR STUDYING THE RADIOCHEMICAL EFFECT OF ELECTRICAL DISCHARGES AT HIGH TEMPERATURES. G. Foeldiak. Translated from Chem. Tech. (Leipzig), 13: 748-9(Dec. 1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 13095.

28986 (JPRS-14524) PRODUCTION OF ARTIFICIAL RADIOISOTOPES IN YUGOSLAVIA. Cedomir Teofilovski. Translated from Tehnika (Belgrade), 17: 837-42(1962). 15p.

A survey is presented of problems associated with production of artificial radioisotopes by irradiation of material in reactors or by treatment of nuclear fuels. Details of artificial radioisotope production at the Boris Kidrich Institute in Belgrade are included. (J.R.D.)

28987 EFFECTS OF GAMMA RADIATION ON ALKALINE SOLUTIONS OF SODIUM THIOSULFATE. J. Ortega Abellán (Junta de Energia Nuclear, Madrid). Anales real soc. españ. fís. y quím. (Madrid), Ser. B, 57: 773-80(Dec. 1961). (In Spanish)

The effect of gamma radiation from a Co^{60} source of 10 r/hour on alkaline solutions of sodium thiosulfate is studied. By chemical analysis, gamma radiation is concluded to destroy two thiosulfate ions, with the simultaneous formation of the one disulfide ion and three sulfite ions as well, and the disappearance of 3 AH^-. The variation of energy yield of thiosulfate destruction, G, for variable concentrations of this compound is determined. G increases with concentration until a constant value of 1.3 for a 0.06 M concentration is obtained. From the analytical data and the obtained energy yield, the following radiolytic reaction is suggested: $2S_2O_3^= + 4OH + 2H \rightarrow SH^- + 3SO_3^= + 3H^+ + H_2O$. (auth)

28988 IDENTIFICATION OF POLYPHENYLS FORMED IN THE RADIOLYSIS OF BIPHENYL BY REVERSE ISOTOPE DILUTION ANALYSIS. Hiroaki Koyama, Gen-ichi Tsuchihashi, and Akibumi Danno (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 35: 696-7 (Apr. 1962). (In English)

C^{14}-labeled biphenyl was irradiated with 4×10^7 r gamma rays at 100°C in vacuum and the radiolytic yields of terphenyls and quaterphenyls determined. The G-values were found to be 6.3×10^{-3}, 1.2×10^{-3}, and 8.3×10^{-4} for o-, m-, and p-terphenyls and 4.9×10^{-3}, 5.1×10^{-3}, and 1.04×10^{-2} for o,o'-, m,m'-, and p,p'-quaterphenyls, respectively. The results indicate that the rate of C-H bond rupture is of the same magnitude as that of C-C (phenyl-phenyl) bond rupture and that there is an orientation effect in the substitution reaction of biphenyl with phenyl and biphenyl radicals. (D.L.C.)

28989 HOT-ATOM REACTION IN CIS- AND TRANS-DINITROTETRAMMINE COBALT(III) NITRATE. Nobufusa Saito, Hirotoshi Sano, Takeshi Tominaga, Fumitoshi Ambe, and Takeo Fujino (Tokyo, Univ.). Bull. Chem. Soc. Japan, 35: 744-7(May 1962). (In English)

The Szilard-Chalmers reaction of cobalt in cis- and trans-dinitrotetrammine cobalt(III) was investigated. After a given isomer was irradiated, Co^{60} was found in an appreciable amount in the other isomeric form. The distribution of Co^{60} in cis-$[Co(NH_3) \cdot (NO_2)_2]NO_3$ irradiated for one hour is 20.5 per cent in the cis form and 11.9 per cent in the trans form. The distribution in trans-$[Co(NH_3)_4 \cdot (NO_2)_2]NO_3 \cdot H_2O$ is 23.3 per cent in the trans form and 6.7 per cent in the cis form. This observation is consistent with a hot-zone model, where one would expect that the original configuration would not be essentially preserved. (auth)

28990 OXIDATION OF FERROUS IONS IN AQUEOUS SOLUTIONS BY COBALT-60 GAMMA RAYS. III. THE EFFECT OF CUPRIC ION IN AIR-FREE ACIDIC SOLUTIONS. Hiroshi Hotta, Shin-ichi Ohno and Nobutake Suzuki (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 35: 762-5(May 1962). (In English)

The yield of ferric ions in the air-free ferrous acidic solutions by cobalt-60 gamma rays is reduced in the presence of cupric ion due to their reduction by the hydrogen atoms. The decrement depends on the composition of the solutions. That is, the apparent ratio of this reduction rate to the oxidation rate of the ferrous ions, estimated directly from the observed ferric yield, increases with the decrease in acidity. On the other hand, the similar

ratio for the reduction rate of ferric ions apparently varies according to the composition of the solutions. However, when these apparent ratios are analyzed by a fine composition of the solutions or reduced to the reaction rate for the fine species in solutions, the intrinsic ratios of the reduction rate of the free ferric and cupric ions to the oxidation rate of the free ferrous ions, by the hydrogen atoms, are 7 and 270 respectively and are independent of the composition of the solutions. On the other hand, the direct capture reaction of the cupric ions with the thermerized electrons is effective, in addition to the above reduction reaction with the hydrogen atoms, in the cupric solutions more concentrated than 0.004 M. (auth)

28991 RADIATION-INDUCED ADDITION OF TRITIUM TO CARBON-CARBON DOUBLE BONDS. R. F. Nystrom and N. S. Rajan (Univ. of Illinois, Urbana). Chem. & Ind. (London), 1165-6(July 29, 1961).

Evidence was obtained for a free-radical component in labeling of organic compounds with tritium. (M.C.G.)

28992 BETA RADIATION SELF ABSORPTION OF PRECIPITATES COLLECTED ON FILTER PAPER; STUDIES WITH S^{35}-BARIUM SULFATE. Raymond G. Gottschalk, Hans Hoch, and George H. Stidworthy (Veterans Administration Center, Martinsburg, W. Va.). Clin. Chem., 8: 318-32(June 1962).

In determining the specific activity of S^{35} precipitated as $BaS^{35}O_4$ in the presence of carrier $BaSO_4$ it is necessary to make corrections for absorption and scattering of beta emission. Different yields of precipitate and different types of self-absorption curves were obtained when S^{35} was precipitated as $BaSO_4$ in the presence and absence of salt. An equation was derived for expressing the self absorption of precipitates collected on filter paper which taken into account the yield of precipitate and the partial penetration of the precipitate into the filter paper. From the computed estimates of the parameters, it was concluded that the precipitate obtained in the absence of salt penetrates into the filter paper. This conclusion was supported by microscopic observations. The Denis method of oxidation followed by Ba precipitation and filtration is well suited for the determination of total and isotopic S because of complete recovery and lack of penetration of the precipitate into the filter paper. The count rates of S^{35} treated by this method fit the usual equation reflecting an exponential absorption of beta radiation better than empirical linear relations. A filtration apparatus is described which permits determination of the radioactivity of a precipitate without removing the filter paper from its support. Because numerous physical factors modify the activity of thin layers of beta emitters, it is essential for calibration to duplicate all the conditions of the experiment, including the mode of preparation of the radioactive material, and to verify that the chosen equation does not introduce a systematic error. (H.H.D.)

28993 AN ELECTRIC CHARGE EFFECT IN THE RADIOCHEMICAL POLYMERIZATION OF SOLID ACRYLONITRILE. Yasuo Amagi and Adolphe Chapiro. Compt. rend., 255: 299-300(July 9, 1962). (In French)

During the radiochemical polymerization of solid acrylonitrile at −196°, the reaction is stopped after a limited conversion of 4 to 5%. By connecting the irradiation cell containing the monomer to ground or to the positive pole of a dry cell, this limited conversion is exceeded. It is thought that the contact with ground prevents the accumulation of electric charges in the irradiated medium and their premature neutralization before the polymerization initiation. (tr-auth)

28994 CHEMICAL REACTIVITY OF IODINE-132 FORMED BY DISINTEGRATION OF TELLURIUM-132. Madeleine Bacher and Jean-Pierre Adloff. Compt. rend., 255: 304-6(July 9, 1962). (In French)

The behavior of I^{132} formed by the decay of Te^{132} introduced as tellurium tetrachloride in an organic medium was studied. The products of the radiosynthesis are analyzed by chromatography in the gaseous phase. (tr-auth)

28995 THE EFFECTS OF IONIZING RADIATION ON GELATIN. Leonard Paul Prusak (Rutgers Univ., New Brunswick, N. J.). Dissertation Abstr., 23: 90(July 1962).

Gelatin fractions obtained from a common source, but differing in molecular weight, were dissimilarly influenced by high energy radiation emanating from an electron beam. The fraction with an average molecular weight of $\sim 1.7 \times 10^5$ showed intrinsic viscosity values inversely proportional to irradiation dose. At the lowest radiation level, the protein increased in molecular weight, but gradual exposure to higher levels induced progressively lower molecular weight values. The intrinsic viscosity of the gelatin fraction of average molecular weight $\sim 8.6 \times 10^4$ was low on initially small irradiation impact, but increased as the radiation was intensified. Neither irradiated 5% solutions nor films gave consistent [η] values in dilute solution viscometry at low ionization levels. Decarboxylation and deamination occurred in irradiated gelatin solutions in proportion to absorbed dose. Dilute solutions of the low molecular weight fraction were not severely damaged by low energy radiation, but the higher molecular weight fraction was injured at the imidazole portion. It is concluded that the end effects of low level irradiation emanating from an electron beam upon fractions of gelatin obtained from the same source are predictable only to the extent that free radical and carbonyl group formation occur. The presence or absence of water in the system being irradiated also determines the extent of denaturation as reflected in carbonyl group formation. In view of extensive free radical formation and strong indications of solvent : solute interaction during the irradiation event, it is inferred that increases in molecular weight in irradiated dilute gelatin solutions can be attributed to crosslinking through covalent and weak hydrogen bonds. (auth)

28996 EFFECT OF X-RADIATION ON THE ELECTROCHEMICAL OXIDATION OF FORMIC ACID ON Pt ELECTRODE. P. I. Dolin, D. V. Kokoulina, S. A. Brusentseva, and S. A. Kabakchi (Inst. of Electrochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1081-4(1962). (In Russian)

Many electrochemical oxidation reactions are kinetically inhibited on Pt anodes and necessitate further work for the complete understanding of the inhibiting mechanism in order to eliminate it. In view of the known effect of ionizing radiation on dilute aqueous solutions, resulting in the formation of radiolytic products, such as H_2 and H_2O_2 together with short-lived atomic H and OH radical, the anodic oxidation of formic acid on a rotating Pt electrode under the influence of x radiation was polarographically investigated. Solutions containing 1N H_2SO_4 and various amounts of HCOOH were used for the experiments carried out at 26 to 27°C at dose rates of 5.04×10^{16} and 5.02×10^{17} ev/cm^3 min. Three maxima, at 0.55, 0.9, and 1.5 v, and corresponding minima were noted on the polarogram. The first maximum was found to increase with increasing dose, reaching a stationary level at the 0.5×10^{19} to 1.1×10^{19} ev/cm^3 range. Saturation of the unirradiated solution with N_2 resulted in a higher value of the first maximum than saturation with air, due to the reduction of O_2 in the latter

case. Upon irradiation in a N_2 atmosphere, the first maximum was decreased, probably because of the poisoning of the Pt electrode with the radiolytic formaldehyde. The increase of the third maximum upon irradiation is explained by the oxidation of the radiolytic H_2O_2; a similar effect was noted when H_2O_2 was added to unirradiated solutions. In addition to effects due to radiation, the excitation of photoconductivity of the surface oxide layer is partially responsible for the increase of the maximum. (TTT)

28997 APPLICABILITY OF THE HOMOGENEOUS KINETIC EQUATIONS TO RADIOLYSIS AT HIGH RADIATION INTENSITIES. B. V. Ershler and V. M. Byakov. Doklady Akad. Nauk S.S.S.R., 144: 1103-4(1962). (In Russian)

Radiolytic phenomena due to soft and hard γ quanta and to fast electrons at absorbed energies of about 10^{13} to 10^{16} ev/cm^3 sec can be conveniently defined by homogeneous chemical kinetics equations, as shown among other factors by the applicability of the $I^{1/2}$ law. Using the data given by A. K. Pikaev and P. Ya Glazunov (Izvestiya Akad. Nauk SSSR, Otdel. Khim. Nauk, 2244(1959); Doklady Akad. Nauk SSSR 130: 1051(1960)), an attempt was made to demonstrate that the radiolytic process up to high dose rates can be expressed by a simplified model. In solutions containing $FeSO_4 + O_2$ the Fe^{2+} ion in concentrations of 1 to 2×10^{-3} N acts as the acceptor of the OH radicals while the O_2 molecules with a concentration of an order of magnitude lower in the solution saturated with air, act as the acceptor of the H atoms. As the irradiation is increased the concentration of the radiolytic products also continue to increase, competing with the oxidation reaction which is slowed down. A generalized equation was derived on the basis of steady-state conditions, successfully defining the situation. It appears desirable to extend these studies in order to determine more precisely the kinetic reaction constants of the recombination reaction and to define more accurately the limits of applicability of the homogeneous kinetic equation to radiolysis. (TTT)

28998 NEUTRON ACTIVATION OF SODIUM IN ANTHROPOMORPHOUS PHANTOMS. F. W. Sanders and J. A. Auxier (Oak Ridge National Lab., Tenn.). Health Phys., 8: 371-9(Aug. 1962).

The feasibility of using phantoms filled with a homogeneous aqueous solution of NaCl in the determination of the relationship between neutron dose and Na^{24} production was investigated using phantoms, burros, and the LASL Godiva II and ORNL Tower Shielding Facility II reactors. The Na^{24} production per unit neutron dose was measured in man-shaped phantoms, cylinders, and burros. It was found that: the ratio of the concentrations of Na^{24} and Na^{23}, (Na^{24}/Na^{23}), in circulated blood is equal to the ratio in the whole body; the inhomogeneity of the distribution of Na in living animals is not significant in the production of Na^{24}; a phantom filled with NaCl solution can be used to approximate a living animal in experiments involving the production of Na^{24} by neutron irradiation; the size of a body and its orientation with respect to the source of neutrons has an effect on the magnitude of the Na^{24} production; and if analyses of blood samples are used to determine Na^{24} production in the burro, the exact time of sampling, within the range of 2—24 hr post-irradiation, is not important. (auth)

28999 ETHYL RADICAL REACTIONS: GAMMA RADIOLYSIS OF CYCLOPROPANE IN THE PRESENCE OF C_2H_3T SCAVENGER. H. Umezawa and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc., 84: 3077-85(Aug. 20, 1962).

The chemical alterations of C_2H_3T were investigated during the Co^{60} gamma radiolysis of cyclopropane (700 mm) and ethylene–propylene (0.2 to 30 mm). The H atoms formed in radiolysis react with the olefins, and the reactions of $C_2H_4T\cdot$ radicals account for almost all of the observed changes in the radioactivity distribution. Recombination reactions with $C_2H_4T\cdot$ radicals demonstrate the presence of ethyl and isopropyl radicals from H atom reactions with olefins. The relative rate of addition to C_2H_4 and $CH_3CH=CH_2$ is approximately $\frac{2}{3}$. Recombination reactions also show the presence of methyl, allyl, vinyl, and n-propyl radicals. The methyl and allyl radicals presumably are formed by the neutralization of $C_4H_9^+$ ions originating in the ion-molecule reaction, $C_3H_6^+ + C_3H_6 \rightarrow C_4H_9^+ + C_2H_4$. C_2H_4T is formed by disproportionation reactions, and leads to upper limits for the ratios of disproportionation to recombination of 0.15 ± 0.02 and 0.35 ± 0.02 for C_2H_4T with ethyl and isopropyl, respectively. Tritiated cyclopropane is also found in low yield. (auth)

29000 EFFECTS OF HIGH ENERGY RADIATIONS ON $\alpha,\beta,\gamma,\delta$-TETRAPHENYLPORPHINE. II. FORMIC ACID, ACETIC ACID AND PROPIONIC ACID AS SOLVENTS. Anton Szutka, J. F. Hazel, and Wallace M. McNabb (Univ. of Detroit and Univ. of Pennsylvania, Philadelphia). J. Am. Chem. Soc., 84: 3090-2(Aug. 20, 1962).

The stability of porphyrins toward irradiations was studied. $\alpha,\beta,\gamma,\delta$-Tetraphenyl porphine was used as a model system. The compound was irradiated in formic acid, acetic acid, and propionic acid with 118 kv, 10 ma x-ray and Co^{60} gamma rays and the eventual changes were followed spectrophotometrically. In contrast to the behavior in sirupy phosphoric acid and sulfuric acid, no significant changes were noted on irradiation with low dosages up to approximately 5000 r. The higher dosages produce changes, which were interpreted as destruction of the porphine ring. A mechanism involving one and/or two electron oxidation followed by disproportionation is suggested. Hydroxyl and perhydroxyl radicals as well as hydrogen peroxide and peracids seem to be responsible for the oxidation. (auth)

29001 THE EFFECT OF RADIATION ON THE REACTIONS OF RECOIL CARBON-11 IN AMMONIA. Fulvio Cacace and Alfred P. Wolf (Brookhaven National Lab., Upton, N. Y.). J. Am. Chem. Soc., 84: 3202-4(Aug. 20, 1962). (BNL-6074)

The reaction of gaseous NH_3 with C^{11} recoil atoms produced by the $N^{14}(p,\alpha)C^{11}$ reaction was studied with a 10-Mev proton beam. The major products are methane-C^{11} and methylamine-C^{11}, whose respective yields change from 45 and 37% at low doses (10^{-4} to 10^{-3} ev/molecule) to 97 and 3% at high doses (1 ev/molecule). At low doses, a third species appears which is readily reduced to give methylamine-C^{11} and may be methylenimine, cyclodiazomethane, or diaminomethane. The results show that the primary products react with the reactive species produced by the radiolysis. (D.L.C.)

29002 ELECTRON SPIN RESONANCE OF A γ-IRRADIATED SINGLE CRYSTAL OF N-ACETYL METHIONINE. Ernesto Cipollini and Walter Gordy (Duke Univ., Durham, N. C.). J. Chem. Phys., 37: 13-17(July 1, 1962).

Free radicals produced by γ irradiation of single crystals of N-acetyl methionine were investigated through their electron spin resonance patterns for different orientations in the magnetic field. Two chemically different free radicals were found, both relatively stable at room temperature. One of them has an ESR pattern very similar to that of cystine dihydrochloride. Analysis of this resonance shows that

the electron spin density is concentrated mainly on the S in a free radical which probably has the chemical form $CH_3CONHCH(COOH\cdot)CH_2CH_2S$. The g tensor for this radical is anisotropic with principal values 2.004, 2.029, and 2.064. An isotropic doublet hyperfine structure of 9.5-G spacing is observed. The second resonance has a complex, incompletely resolved, hyperfine structure with a total spread of about 26 G. Its almost isotropic g tensor with principal values from 2.002 to 2.005 indicates that the electron spin density is concentrated on a carbon. The free radical is believed to have the form $CH_3CONH\dot{C}(COOH)CH_2CH_2SCH_3$, but this structure is not proved. (auth)

29003 KINETICS OF DISAPPEARANCE OF RADICALS TRAPPED IN IRRADIATED POLYETHYLENE. W. V. Smith and B. E. Jacobs (U. S. Rubber Co., Wayne, N. J.). J. Chem. Phys., 37: 141-8(July 1, 1962).

Development of a technique for determining the concentration of alkyl radicals trapped in irradiated polyethylene using radio-iodine is described. It is applied to study the kinetics of alkyl radical disappearance in irradiated polyethylene and polypropylene, and the kinetics are interpreted in terms of a simple model. The radicals are assumed to be formed in isolated spherical spurs and rapidly attain an approximately uniform concentration within a spur. This concentration decreases with time due to second-order recombination accompanied by a diffusion-like expansion of the spur. Recombination is increased by hydrogen and the diffusive expansion is increased by hydrogen and by preirradiation. Both processes are faster in polypropylene than in polyethylene. The number of free radicals per spur after the irradiation decreases with increase in radiation dose, due probably to the effect of the hydrogen produced by irradiation. (auth)

29004 RADIATION DECOMPOSITION OF AQUEOUS AZIDE SOLUTION. Kenichi Shinohara, Tadamasa Shida, and Nobufusa Saito (Tokyo Univ.). J. Chem. Phys., 37: 173-7(July 1, 1962).

When an aqueous solution of azide ion is irradiated with γ rays of Co^{60}, nitrogen gas, hydroxyl ions, and ammonia are produced. Hydrogen peroxide is not formed while hydrogen is produced equal to $G^{w}_{H_2}$. The reaction mechanism may be well explained by assuming the oxidation of azide ion by the hydroxyl radical and the reduction by the hydrogen atom. Applying the expanding-spur theory of Ganguly and Magee to the system, all the features of the radiolysis are well understood. The number of water molecules initially decomposed was determined as 5.5. The rate constant of the reaction, $OH + N_3^- = OH^- + N_3$, was calculated to be 8×10^{10} liter mol^{-1} sec^{-1}. (auth)

29005 X-IRRADIATION DAMAGE OF SUCROSE SINGLE CRYSTAL. Howard Shields and Phillip Hamrick (Wake Forest Coll., Winston-Salem, N. C.). J. Chem. Phys., 37: 202-3(July 1, 1962).

Sucrose single crystals were exposed to 10^6 r of 30 kv x radiation and the radioinduced radicals studied with electron spin resonance spectra. The results indicate that a radical of the formula $RCHOH\dot{C}HCHOHR$ is formed by loss of an OH group from a sucrose molecule. The unpaired electron is shown to interact with H groups on either side and not with OH groups. (D.L.C.)

29006 VACUUM ULTRAVIOLET PHOTOLYSIS OF METHANE. Bruce H. Mahan and Robert Mandal (Univ. of California, Berkeley). J. Chem. Phys., 37: 207-11 (July 15, 1962).

The photolysis of CH_4-CD_4 mixtures, CH_2D_2, and CHD_3 with 1236Å light shows that molecular elimination of hydrogen from methane is an important but not an exclusive primary photochemical process. The photolysis products are principally those expected from the insertion reaction of the methylene radical. (auth)

29007 ELECTRON MAGNETIC RESONANCE OF AN ORIENTED ALLYL-TYPE FREE RADICAL. C. Heller and T. Cole (Ford Motor Co., Dearborn, Mich.). J. Chem. Phys., 37: 243-50(July 15, 1962).

It was found that x irradiation of a single crystal of glutaconic acid $(HOOC)CH = CH-CH_2(COOH)$ produces the oriented allyl-type free radical $(HOOC)C(1)H = C(2)H-C(3)H(COOH)$. A detailed analysis of the electron magnetic resonance spectra of this radical confirms that the spin density on carbon 2 is opposite in sign to the spin densities on carbons 1 and 3. Additional structural features determined are: (a) the unpaired electron occupies a delocalized π molecular orbital extending over carbon atoms 1, 2, and 3; (b) spin densities ρ_{ii} for carbon p orbitals on carbon atoms 1, 2, and 3 are $\rho_{11} = \rho_{33} = +0.57$, $\rho_{22} = -0.19$; (c) principal values of the hyperfine tensors for protons 1 and 3 are -53, -36, and -18 Mc, and for proton 2 are +17, +12, +7 Mc; (d) all C–H bonds in the radical are nearly parallel. The parallelism of all C–H bonds indicates that the undamaged parent molecule is the trans isomer of the acid. (auth)

29008 ELECTRON SPIN RESONANCE OF AN IRRADIATED SINGLE CRYSTAL OF N-CARBAMYL GLYCINE. D. V. G. L. Narasimha and Mikio Katayama (Duke Univ., Durham, N. C.). J. Chem. Phys., 37: 382-4(July 15, 1962).

The electron spin resonance spectra of γ-irradiated single crystals of N-carbamyl glycine were measured at 9 and 23 kMc/sec for various orientations of crystals in the external magnetic field. From the analysis of the hyperfine-interaction constants, the free radical produced by γ irradiation is found to be $NH_2CONH\dot{C}HCOOH$. The spin density at the carbon atom is 75% and the free radical is similar to that produced from acetylglycine and glycylglycine. (auth)

29009 EXPERIMENTAL INVESTIGATION OF THE EFFECT OF IRRADIATION INTENSITY ON THE PRODUCTION OF F CENTERS IN NaCl. Patrick G. Harrison (United Aircraft Research Labs., East Hartford, Conn.). J. Chem. Phys., 37: 388-92(July 15, 1962).

The effect of x-ray intensity on the room temperature production of F centers was studied experimentally. It was found that the initial rate of production (number of F centers produced per incident photon) is independent of intensity. However, the total first-stage coloration that can be produced increases with increasing intensity. Part of the first-stage coloration produced by a high-intensity radiation is bleached upon reducing the intensity. The coloration in the second stage was found to be independent of the intensity. The rate of coloration in the third stage (the relatively rapid coloration following the second stage) was found to increase with increasing intensity. The excess third-stage centers produced by a high-intensity radiation over those that would be produced by an equivalent lower intensity radiation were bleached upon reducing the intensity to the lower value. (auth)

29010 SYNTHESIS AND PROPERTIES OF THE GRAFTED COPOLYMERS POLY(METHYL METHACRYLATE)–POLYSTYRENE. I. POLYMERIZATION OF STYRENE INITIATED BY PREIRRADIATED POLY(METHYL METHACRYLATE). Itaru Mita (Tokyo Univ.). J. chim. phys., 59: 525-9(June 1962). (In French)

The grafting reactions of styrene on poly(methyl methac-

rylate) preirradiated with Co^{60} gamma rays were studied. The solidified radicals in the platelets of poly(methyl methacrylate) irradiated under vacuum were detected chemically. Their quantity increases with the irradiation dose and then reaches a plateau. On the other hand, the peroxide groups which exist in the polymer before irradiation are destroyed by the irradiation under vacuum. The irradiation of the poly(methyl methacrylate) in the presence of air produces peroxides capable of initiating the polymerization of the styrene. This peroxidation depends to a great extent on the form of the samples used. In the case of a fine powder, the concentration of the peroxide groups increases regularly with the dose; in the case of platelets, the concentration reaches a plateau after several megarads. Likewise, poly(methyl methacrylate) in granules is only difficultly oxidized. (tr-auth)

29011 SYNTHESIS AND PROPERTIES OF THE GRAFTED COPOLYMERS POLY(METHYL METHACRYLATE)–POLYSTYRENE. II. FORMATION OF GRAFTED COPOLYMERS BY DIRECT IRRADIATION AND CHARACTERIZATION OF THE PRODUCTS OBTAINED BY LIGHT SCATTERING. Itaru Mita (Tokyo Univ.). J. chim. phys., 59: 530-6(June 1962). (In French)

Homogeneous solutions of poly(methyl methacrylate) in styrene were exposed to Co^{60} gamma rays. The rate of the styrene polymerization obeys the classical law of the kinetics of radiochemical polymerization but it seems to be affected by energy transfers. The curve for the precipitation of the crude polymer formed during the irradiation was compared to that of a mixture of two homopolymers. The differences observed prove the existence of the grafted copolymer which can be separated by fractionation. The grafted copolymer yield is less than can be explained if the radiolysis severs only the principal chains of the polymethacrylate. It seems that small radicals formed by the radiolysis of lateral branches of the polymethacrylate contribute to the homopolymerization of the styrene. A recent theory on the scattering of light by copolymers was applied to the grafted copolymer. It was found that this grafted copolymer is polydispersed both in mass and in composition, but the composition polydispersion is not very large. The comparison of the molecular mass and the gyration radius of the grafted copolymer with those of nongrafted polystyrene and poly(methyl methacrylate) leads to the conclusion that the grafted copolymer has, on an average, two branches of polystyrene per chain of poly(methyl methacrylate) and that the copolymer is branched. (tr-auth)

29012 RADIOCHEMICAL POLYMERIZATION OF SOME VINYL MONOMERS AT LOW TEMPERATURES. Yasuo Amagi and Adolphe Chapiro (Centre National de la Recherche Scientifique, Bellevue). J. chim. phys., 59: 537-57(June 1962). (In French)

The radiochemical polymerization of acrylonitrile styrene and of methyl methacrylate was studied in solution in a polar solvent at low temperature and in the solid state. The kinetics of the polymerization of the styrene dissolved in ethyl bromide at low temperatures is analogous to that which has been observed previously in different chlorated solvents but it is different in several respects. This reaction is inhibited by oxygen and benzoquinone; the contribution of a radical mechanism to the total reaction seems more important in the case of the bromated solvent. The polymerization of the acrylonitrile in dimethylformamide seems to proceed by a radical mechanism even at −78°. The irradiation of the methyl methacrylate in this same solvent at −78° gives practically no polymer. The radiochemical polymerization of solid acrylonitrile at −196° is followed by a very marked post-polymerization. This reaction is shown in particular when the irradiated mixture is reheated before the polymer is separated. A technique for following this post-polymerization during the reheating is given; this technique consists in a rapid melting of the reaction mixture at different periods after the end of the irradiation and a determination of the quantity of the polymer formed. The post-polymerization was also studied in the solid phase at constant temperature. The Arrhenius diagram of the initial velocity has a break near −140°. The total activation energy is 0.8 kcal/mole between −83 and −140°. The effect of numerous additives is examined; all decrease the polymerization rate. The radiochemical polymerization of solid styrene follows kinetics analogous to that of acrylonitrile. There is a sharp acceleration during the passage from the liquid to the solid state. In the solid state the activation energy of the total reaction is 11.6 kcal/mole. Some additives, such as nitrobenzene, o-dichlorobenzene, and hydroquinone, increase the reaction rate. Methyl methacrylate shows practically no polymerization when it is irradiated in the solid state. However, if some compounds with high viscosity, such as paraffin oil or castor oil, are added to the monomer, abundant polymerization is observed. The reaction was examined in detail in the case of mixtures of methyl methacrylate with paraffin oil. This system has a kinetic behavior analogous to that of acrylonitrile and of solid styrene. However, the conversion curves are accelerated with time. Iodine, benzoquinone, and oxygen inhibit the reaction. Beginning with the results of the present work and with literature data, the radiochemical yield of the initiation of polymerization in the solid phase was calculated. It was found that the G values (initiation centers) are found between 0.1 and 0.5 for the different systems examined, that is, they are of the same order of magnitude as the corresponding G values for ionic polymerizations and the G values (trapped radicals) in the solid monomers. (tr-auth)

29013 REMARKS ON THE RADIOCHEMICAL GRAFTING OF STYRENE ON POLYISOBUTYLENE. Jeanne Sebban-Danon (Faculté des Sciences, Orsay, France). J. chim. phys., 59: 558-9(June 1962). (In French)

The experimental data of previous work were examined in the light of new considerations. A difficulty arises in determining the mechanism of the radiolysis of polyisobutylene in solution in styrene. (tr-auth)

29014 EFFECT OF γ RAYS ON AQUEOUS SOLUTIONS OF POTASSIUM THIOCYANATE. Marcelle Duflo (Laboratoire Curie, Paris). J. chim. phys., 59: 655-6(June 1962). (In French)

The radiolysis of aqueous solutions of potassium thiocyanate with γ rays was studied. The irradiation of a 5×10^{-3} M solution of the thiocyanate in the presence of air in a neutral solution with a γ intensity of 2 to 8×10^{18} ev/cm^3 hr causes the formation of sulfate and cyanide in almost equivalent quantities. No hydrogen peroxide was detected. For thiocyanate concentrations between 2×10^{-3} and 10^{-1} M, the initial yields remain constant and equal to $G(-SCN^-) = 1.3$, $G(CN^-) = 1.1$, $G(SO_4^{2-}) = 1.0$, and $G(S_1) = 0.3$. The yields decrease during the irradiation if oxygen is bubbled through the solution. For high radiation doses traces of ammonia are observed which increase with the dose. The yields decrease in degassed solutions. A qualitative interpretation of the results is given. (J.S.R.)

29015 THE γ-RAY RADIOLYSIS OF METHYL SUBSTITUTED BORAZOLES. Clarence J. Wolf and Richard H. Toeniskoetter (Union Carbide Corp., Parma, Ohio). J. Phys. Chem., 66: 1526-9(Aug. 1962).

The 100 ev yields of hydrogen, methane, and ethane from

the cobalt-60 γ-ray radiolysis of N-trimethyl-, B-trimethyl-, and hexamethylborazole are independent of dose and dose rate. At 30°, the hydrogen, methane, and ethane yields are, respectively, 3.53, 0.015, and <0.01 for N-trimethylborazole; 1.65, 1.38, and 0.08 for B-trimethylborazole; and 0.45, 0.83, and 0.28 for hexamethylborazole. Hydrogen is the predominant product at −196 and −78°. Between −6 and 100° the methane yields from irradiated hexamethyl- and B-trimethylborazole change more with temperature than the corresponding hydrogen and ethane yields. Above 100°, however, the methane yields vary only slightly with temperature. The methane yield from N-trimethylborazole is low regardless of irradiation temperature. (auth)

29016 RADIOLYSIS OF TOLUENE: MECHANISM OF FORMATION OF BENZYL RADICALS. L. H. Gale, B. E. Gordon, G. Steinberg, and C. D. Wagner (Shell Oil Co., Martinez, Calif. and Shell Development Co., Emeryville, Calif.). J. Phys. Chem., 66: 1538-9(Aug. 1962).

Toluene-α-C^{14} was irradiated with 3-Mev electrons and the products analyzed for activity on the ring and carbonyl. All of the activity was found on the carboxyl carbon, and it is concluded that the mechanisms for formation of benzyl radicals is by direct C-H scission and does not involve tropylium ions. (D.L.C.)

29017 RADIOLYSIS OF FERROUS SULPHATE SOLUTIONS WITH STANDARDISED INTERNAL SOURCES OF POLONIUM-210. J. Steyn and D. Van As (South African Council for Scientific and Industrial Research, Pretoria). J. S. African Chem. Inst., 14: 93-7(Oct. 1961). (In English)

The radiolytic yield of ferric ions in both aerated and deaerated "Fricke" dosimeter solutions was determined for irradiation with internal sources of the α-emitter polonium-210. The radioactivity was standardized by 4π-liquid scintillating counting. The following G-values were found: Aerated solution: 5.08 ± 0.02; Deaerated solution: 3.53 ± 0.01. (auth)

29018 EFFECT OF THIOUREA ON THE IRRADIATION INDUCED OXIDATION OF CYSTEIN IN AQUEOUS SOLUTION. L. Guczi. K[özponti] É[lelmiszeripari] K[utató] I[ntézet] Közlemények, 33-4[(1961)]. (In Hungarian)

The effect of thiourea on hydrogen sulfide formed in the course of oxidation of cysteine induced by irradiation was investigated. S^{35}-cysteine HCl was used, and the specific activity and concentration of hydrogen sulfide was determined by the double inverse isotope dilution method. The results show that thiourea increased the yield of hydrogen sulfide, the elementary sulfur formed from thiourea by irradiation was not produced from hydrogen sulfide. (auth)

29019 A NEW CHEMICAL DOSIMETRY FOR MEASURING HIGHER LEVEL γ-RAYS USING A TITANIUM SULPHATE SOLUTION. Takanobu Shiokawa (Tohoku Univ., Sendai) and Kunihiko Hasegawa. Nature, 195: 592-3 (Aug. 11, 1962).

An attempt was made to develop a new chemical dosimeter for doses higher than 10^6 r, and a new method was developed depending on the resulting orange-yellow color in titanium sulfate solutions caused by irradiation. According to experimental results, the coloration did not depend on the γ-ray dosage rate in the range 6×10^4 to 6×10^5 r/hr, but it was influenced to some extent by the concentrations of titanium sulfate and sulfuric acid. The G-value at a lower concentration of titanium sulfate tended to be larger, but less reproducible. The G-value of the coloration induced by γ irradiation in a solution containing 0.8 N sulfuric acid and a 0.02 M titanium sulfate solution was estimated to be 1.03 with fairly good reproducibility. But if 0.8 N sulfuric acid solutions were irradiated and then a titanium sulfate solution added just before the photometric measurement, the value was about 0.53. The difference between the two values is understood to be due to secondary reactions or after-effects of the initial products in the solution after irradiation. (P.C.H.)

29020 OXYGEN EFFECT AS AN EXPLANATION OF DIFFERENCES BETWEEN THE ACTION OF α-PARTICLES AND X- OR γ-RAYS ON AQUEOUS SOLUTIONS OF AMINO-ACIDS AND PROTEINS. A. J. Swallow and J. A. Velandia (Imperial Coll. of Science and Tech., London). Nature, 195: 798-800(Aug. 25, 1962).

Differences in extinction coefficients between irradiated and unirradiated solutions for 2×10^{-4} M tryptophan irradiated with γ rays (66400 rads) in the absence of air, in the presence of air, and in the presence of 10^{-3} M H_2O_2 (air absent) are compared with previously obtained results. Results with γ rays in the absence of oxygen are in reasonable agreement with other results, while results in the presence of oxygen or H_2O_2 show similar qualitative features with α particles under nitrogen, that is, compared with the result of x or γ irradiation in the absence of oxygen, they show a larger drop in extinction coefficient near the tryptophan absorption peaks at 279 and 287 mμ, a larger rise below about 270 mμ, and an increased production of a substance or substances absorbing above 300 mμ. This suggests that the α particles are acting through the formation of oxygen and/or hydrogen peroxide from the water, simultaneously with free radicals. The loss of tryptophan and the ammonia yield from γ irradiated tryptophan were also measured. (P.C.H.)

29021 EFFECT OF IONIZING RADIATION ON THE KINETICS OF BUTANE OXIDATION. II. MECHANISM OF THE REACTION. N. A. Slavinskaya, G. P. Zhitneva, S. A. Kamenetskaya, and S. Ya. Pshezhetskii (Karpov Inst. of Physics and Chemistry, Moscow). Zhur. Fiz. Khim., 36: 1293-8(June 1962). (In Russian)

Formation of oxides and aldehydes in the butane chain oxidation induced by fast electrons was studied. The results indicate that early branching appears with increased radiation intensity as a result of degradation. (R.V.J.)

29022 PRAKTICHESKOE RUKOVODSTVO PO RADIOKHIMII. (Practical Handbook on Radiochemistry). I. V. Golubtsov, K. B. Zaborenko, B. Z. Ioffe, V. I. Korobkov, A. V. Lapitskii, V. B. Lukyanov, A. N. Nesmeyanov, N. P. Rudenko, V. M. Fedoseev, E. S. Filatov, and L. P. Firsov. A. N. Nesmeyanov, ed. Moscow, Publishing House of Scientific-Technical Literature on Chemistry, 1961. 324p.

Descriptions are given of various devices and installations for recording radioactive emissions. Data and calculations are offered for practical application in microradiography and problems in radiochemistry. (R.V.J.)

29023 PROMOTION OF CHEMICAL PROCESSES WITH REACTOR RADIATION. P. Harteck and S. Dondes (Rensselaer Polytechnic Inst., Troy, N. Y.). Preprint Paper No. 86. New York, Engineers Joint Council, 1962. 27p.

At present, the promotion of chemical processes with reactor radiation is technically feasible but economically it is slowly approaching feasibility. How nuclear reactors can be used to synthesize chemicals, the special fuel element requirements, a conceptual design of a plant to produce nitrogen tetroxide from a nitrogen-oxygen mixture, applicable chemical systems, loop operation, and finally the major problems still to be over-come are discussed. (auth)

29024 TECHNIQUES FOR FAST RADIOCHEMISTRY. W. Wayne Meinke (Univ. of Michigan, Ann Arbor). p.36-

40 of "Proceedings of International Conference on Modern Trends in Activation Analysis, College Station, Texas, 1961."

A number of groups in the past few years have been working on the problem of speeding up procedures. One approach has been to speed up the standard analytical techniques such as precipitation, solvent extraction, and ion exchange using a number of tricks to save time. In addition, several new types of procedures have been developed which promise to effect separations satisfactory for radiochemical purposes within a few minutes. These include techniques such as isotopic exchange, amalgam exchange, focusing ion exchange, selective reduction by polarographic equipment, recoil, centrifugal paper chromatography, etc. Many of these techniques have had only cursory application to radioisotope separations but serious consideration of several of them seems warranted. These rapid separation techniques are being summarized in a monograph now being prepared for the Radiochemical Techniques Series sponsored by the Subcommittee on Radiochemistry of the National Research Council. Highlights of this monograph are reviewed. (auth)

Raw Materials and Feed Materials

29025 (HW-69586(Rev.)) SAFETY REVIEW OF MANUFACTURING FACILITIES CHEMICAL PROCESSING DEPARTMENT. R. E. Tomlinson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 23, 1962. Contract AT(45-1)-1350. 18p.

Safety procedures for the Redox and Purex solvent extraction plants and the plant for processing plutonium to metallic buttons and weapons components are presented. (M.C.G.)

29026 (K-1267) HIGH PRESSURE FLUORINATION OF URANIUM OXIDES. R. E. Greene and G. S. Petit (Oak Ridge Gaseous Diffusion Plant, Tenn.). Aug. 25, 1960. Contract W-7405-eng-26. 14p.

A new method for the laboratory fluorination of uranium oxides using gaseous fluorine at a pressure of about seventy atmospheres was developed. Fluorine is condensed in a metal reactor at liquid nitrogen temperatures onto uranium oxide and an activator, potassium chloride. When the reactor is closed and the coolant removed the fluorine vaporizes and a very rapid fluorination takes place, usually before the reactor reaches room temperature. The method is used routinely to fluorinate gram quantities of uranium oxide to uranium hexafluoride for isotopic analysis with the gas type mass spectrometers. A typical fluorination is completed in fifteen minutes or less. (auth)

29027 (NLCO-855) SUMMARY TECHNICAL REPORT FOR THE PERIOD APRIL 1, 1962–JUNE 30, 1962. R. Burgett, ed. (National Lead Co. of Ohio, Cincinnati). July 25, 1962. Contract AT(30-1)-1156. 84p.

Results of research are reported in which organic impurities were shown to be the principal cause of dispersion band formation in the refinery mixer-settler system. In other work, Aliquot 336 (a quaternary ammonium chloride) diluted with Solvesso 100 was evaluated as an extractant for uranyl chloride liquors resulting from the HCl digestion of low-grade residues. A furnace was built for studying the green salt-magnesium reaction. The propagation rate, using 6- to -4 green salt, was determined. Small-scale crucibles were coated with various refractory materials by plasma spraying. Uranium cast in these crucibles was evaluated for contamination. A study was made to evaluate pickled extrusion skulls and briquetted dingot turnings as feed for the remelt operation. A prototype unit was developed for the spray-washing of salt-heated, oil-quenched U fuel cores. Experiments were performed which indicated that Fe in solid solution in a U matrix does not act ferromagnetically. A method was devised to determine "area weights" for any combination of planes of an orthogonal crystal structure. Areas of spherical polygons for 18 and 20-plane sets of U are tabulated. Stereographic projections were prepared of the fraction of a compressive stress resolved as shear stress on various slip and twinning systems. The "eutectoidal" structure shown by U after electrolytic etching in 1 : 1 nitric acid was not the structure of the metal itself, but, rather, that of an oxide film on the surface. (auth)

29028 (AEC-tr-5070) ON THE REACTIVITY OF URANOURANIC OXIDE (IV). STUDY OF THE SURFACE STRUCTURE OF URANOURANIC OXIDE POWDER BY ELECTRON MICROSCOPE-REPLICA METHOD AND X-RAY DIFFRACTION METHOD. Rokuo Ukaji (Ukazi). Translated from Nippon Genshiryoku Gakkaishi, 2: 598-602(1960). 8p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 8865.

29029 (AEC-tr-5072) ON THE REACTIVITY OF URANOURANIC OXIDE (V). ON RELATION BETWEEN REACTIVITY OF URANOURANIC OXIDES AND CONDITION OF PREPARATION. Rokuo Ukaji (Ukazi). Translated from Nippon Genshiryoku Gakkaishi, 2: 731-5(1960). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 8614.

29030 STUDIES ON METALLIC THORIUM PRODUCTION FROM KOREAN MONAZITE SAND. PART 5. METALLIC THORIUM PRODUCTION BY FUSED SALTS ELECTROLYSIS. Dong-seon Kim, Ju-seong Lee, and Hyung-koo Lee. Kwayon Hwibo, 5: 107-11(1960). (In Japanese)

Metallic thorium production was attempted by fused salts electrolysis in an argon atmosphere, using the thorium fluoride double salts system. The electrolyte was pure thorium salts obtained from processing Korean monazite sands through alkali decomposition and solvent extraction. The bath content consisted of sodium chloride–potassium chloride and thorium salt eutectic. Relations between current densities, reacting temperature, salts ratio and particle sizes were investigated. Results were obtained as follows: 1) Current densities were 20 to 25 amp/dm^2. 2) Optimum temperature was about 800°C. 3) The ratio of thorium salt to alkali halides in bath was unimportant at 15 to 50%. Decreasing the thorium salt content of bath below 5% results in a discharge of alkali metal ions at the cathode. Under these conditions, metallic thorium 99% over in purity and current efficiencies 70 to 75% were obtained. (auth)

29031 CHEMICAL REACTIVITY OF URANIUM TRIOXIDE. PART 1. CONVERSION TO U_3O_8, UO_2 AND UF_4. R. M. Dell and V. J. Wheeler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Faraday Soc., 58: 1590-1607(Aug. 1962).

A kinetic study was made of the reduction of UO_3 to UO_2 by hydrogen and carbon monoxide and of the conversion of UO_3 to UF_4 by hydrogen fluoride. The reduction reaction is an interfacial reaction proceeding via the $UO_{2.6}$ phase, with CO reacting more readily than H_2. The reactivity of UO_3 toward HF is a function of its surface area which increases with (a) lower reduction temperature, (b) the presence of sulfate impurity in the UO_3. The de-

composition of UO_3 to U_3O_8 and conversion of the latter UO_2 and UF_4 was also studied and the kinetics are reported. The rate of hydrofluorination of UO_2 prepared by this route is dependent upon the UO_3 decomposition temperature rather than upon the U_3O_8 reduction temperature. It is shown that for UO_2 to be reactive toward HF it must possess both an adequate surface area ($>2m^2/g$) and sufficient internal porosity to accommodate the volume increase associated with conversion to UF_4. Some experiments on the interaction of UO_2 single crystals with HF are also reported. (auth)

Separation Processes

Refer also to abstracts 29218, 29230, and 30012.

29032 (BNL-749) CHEMICAL DECLADDING OF STAINLESS STEEL FUEL ELEMENTS IN A STAINLESS STEEL DISSOLVER. Progress Report No. 1. Herbert M. Katz (Brookhaven National Lab., Upton, N. Y.). July 1962. Contract [AT(30-2)-Gen-16]. 28p.

A process was developed for the chemical decladding of stainless steel clad-oxide fuel elements in a stainless steel dissolver vessel, which is equipped with a Ni-o-nel basket to prevent contact between the dissolving fuel elements and the vessel walls. The decladding solution is 6-7 M H_2SO_4 containing 0.04-0.08 M HNO_3. The nitrate concentration is sufficient to keep the vessel walls passivated, while permitting the dissolution of the fuel rods to be initiated by contacting with mild steel or Nicrobraz 10. The nitrate concentration is maintained by use of a downdraft condenser, the cold leg of which is sparged with oxygen. Thus the nitric oxide resulting from reduction of nitrate in the presence of dissolving stainless steel is oxidized to NO_2, which is absorbed in the condensate and continuously returned to the solution. Since the presence of nitrate ion increases core losses to the decladding solution, sulfamic acid may be used as an inhibitor. Addition of 0.03 M sulfamic acid to the decladding solution reduces core losses to acceptable values. (auth)

29033 (HW-SA-1911) HIGH FLOW RATE OPERATION OF A DUPLEX ION EXCHANGE SYSTEM. T. F. Demmitt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 2, 1960. Contract [AT(45-1)-1350]. 13p.

Duplex (cation unit followed by an anion unit) deionization tests were run at liquid flow rates corresponding to 10, 25, 50, and 75 gallons per minute per square foot of cross-sectional area. The results of this work indicated that high flow rate operations are feasible and that resin capacities are not greatly reduced by operating the units at high flow rates. The deionization performance of these systems was evaluated from measurements of the effluent specific resistance. The validity of this technique was verified by chemical and spectral analysis of effluent samples taken at various times during the tests. The effluent specific resistance curves were quite similar at all of the flow rates investigated. The breakthrough points were well defined even at the highest flow rate tested. This is in contrast to the results normally obtained with mixed bed deionization systems where the breakthrough curves have reduced acuteness. These tests were conducted using filtered Columbia River water as the influent. The average dissolved solids concentration of this water varied between 85 and 95 parts per million during this test series. The observed pressure drop through the ion exchange columns did not vary appreciably during the exhaustion step. The pressure drop increased quite rapidly with increasing flow rate and was a direct function on the bed depth used. Resin beads exposed to three complete exhaustion and regeneration cycles at an exhaustion flow rate of 75 gallons per minute per square foot of cross-sectional area showed only slight physical damage as determined by variations in the resin particle size distribution. Beads exposed at lower flow rates were therefore not examined for physical deterioration. (auth)

29034 (HW-SA-1912) REDOX INSTRUMENT MAINTENANCE WORKLOAD. A. C. Morgenthaler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 3, 1960. Contract [AT(45-1)-1350]. 12p.

A study was made to measure the amount of trouble call work arising as a package separate from that work which is more readily scheduled. A discussion is included of the "Queueing Theory" which was used on jobs requiring prompt attention to measure the optimum number of persons required for the work. (B.O.G.)

29035 (JEN-99-DQ/I-30) BENEFICIO DE UN MINERAL ESPAÑOL DE CIRCONIO-HAFNIO. SEPARACION DE AMBOS ELEMENTOS POR EXTRACCION LIQUIDO-LIQUIDO, EMPLEANDO FOSFATO DE TRIBUTILO COMO AGENTE DE QUELACION. (A Spanish Mineral of Zirconium and Hafnium. Separation of the two Elements by Liquid-Liquid Extraction, using Tributyl Phosphate as Chelating Agent). F. Ruiz Sanchez, F. de la Cruz Castillo, and R. Fernandez Cellini (Spain. Junta de Energia Nuclear, Madrid). 1962. 20p.

Zirconium and hafnium oxides were obtained from a Spanish mineral of zircon with an average contents of 55% in ZrO_2-HfO_2. An alkaline fusion to open the mineral, followed by a purification by crystallization as $(ZrO-HfO)Cl_2\ 8\ H_2O$ or as $(Zr-Hf)\ (SO_4)_2 \cdot 4H_2O$, was used. A discussion of the best experimental conditions for opening the mineral and of the purification method is presented. The hafnium is separated from the zirconium by solvent extraction with TBP-kerosene systems. A study of the factors affecting in a countercurrent process was made. Several types of contactors were examined: mixer-settlers, packed columns, and vibration columns. Also, consideration was given to the scrubbing and stripping processes, and to the solvent regeneration. Under the experimental conditions used, a HfO_2 contents in ZrO_2 lower than 200 ppm was obtained. (auth)

29036 (JINR-P-1001) EKSTRAKTSIYA FERMIYA I MENDELEVIYA V SYSTEMAKH TBF-HNO_3. (Extraction of Mendelevium and Fermium in TBP-HNO_3). M. Taube, E. Gvuzd, K. A. Gavrilov, Ya. Maly, I. Brandshtetr, and T'ung-seng Wang (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 7p.

The partition ratio of Md, Fm and Cf, Am, Cm, and Eu by TBP extraction from nitric acid solutions was measured. The obtained results are: $D_{Cf} < D_{Eu} < D_{Fm} \leq D_{Md}$ when $4 < D_{Md} < 5.5$, $3.5 < D_{Fm} < 4.5$, for 13.1 M HNO_3. (auth)

29037 (NAA-SR-6905) ORGANIC COOLANT IMPURITIES REMOVAL. G. O. Haroldsen and J. W. Florence (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1962. Contract AT-11-1-GEN-8. 54p.

An experimental investigation was conducted to develop methods and equipment for removing film-forming impurities from high-temperature irradiated organic reactor coolants. Electromagnetic and electrostatic devices as well as several filter types were found to be either ineffective or unsatisfactory for the high-temperature service required. On the other hand, fixed-bed adsorption using

Attapulgus clay, at 550 to 750°F with superficial mass flow rates from 42 to 320 lb/hr-ft^2 of column cross section, successfully lowered the particulate concentration (as indicated by ash analysis) and reduced the fouling tendency of the coolant to acceptable levels. In addition, precoat filtration employing diatomaceous earth filter aids proved equally successful in lowering the particulate content but was somewhat less efficient in decreasing the fouling tendency of irradiated coolant mixtures. The filtration tests were carried out with coolant flow rates between 200 and 480 lb/hr-ft^2 of filter area and at approximately 575°F. (auth)

29038 (ORNL-2971(Vol.7)) BIBLIOGRAPHY ON NUCLEAR REACTOR FUEL REPROCESSING AND WASTE DISPOSAL. VOLUME 7. SURVEYS (GENERAL). T. F. Connolly (Oak Ridge National Lab., Tenn.). Contract [W-7405-eng-26]. 53p.

References (286) are given to books, bibliographies, symposia, journals, and contractors' topical reports published from 1955 to the present. (P.C.H.)

29039 (RAI-101) FOAM SEPARATION. Quarterly Progress Report, January 1, 1962–March 31, 1962. Eliezer Rubin, Ernest Schonfeld, and Richard Everett, Jr. (Radiation Applications Inc., Long Island City, N. Y.). May 2, 1962. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontract 2024. 45p.

Additional experiments were conducted on the effect of Ca^{++} concentration on separation of Cs^{+}. The experimental results, in agreement with the previous studies, indicate that the distribution factor of Cs^{+} decreases rapidly when the concentration of Ca^{++} is between 10^{-5} and 10^{-4} M. The following studies, using dodecyl benzene sulfonate (DBS) as the foaming agent, have been conducted: surface tension determinations, effect of pH on Sr^{++} separation, effect of Ca^{++} concentration on Sr^{++} separation, and effect of DBS concentration on Sr^{++} separation. Experiments on the effect of foaming agent concentration on separation of Sr^{++} and Cs^{+} were conducted with Armosul 16 (alpha-sulfopalmitic acid). Maxima were observed in the distribution factor versus foaming agent concentration curves. Studies on pretreatment of simulated ORNL low level waste with NaOH and Na_2CO_3 were conducted. Up to 98.2% of the total hardness was removed by employing a mixing tank, flocculator and settling column assembly. A Sr^{++} DF of up to 150 was obtained with this apparatus. Experimental 2- and 3-in. diameter multi-stage foam separation columns were installed. These columns are being used in engineering studies. An approximate method for the estimation of multi-stage column throughput capacity was developed. (auth)

29040 O,O'-DIALKYL PHOSPHORODITHIOIC ACIDS AS EXTRACTANTS FOR METALS. Thomas H. Handley (Oak Ridge National Lab., Tenn.) and John A. Dean. Anal. Chem., 34: 1312-15(Sept. 1962).

The solvent extractions of 42 elements as di-n-butyl phosphorodithioates into CCl_4 from 0.03 to 9N HCl and H_2SO_4 media are presented as plots of log distribution ratio vs log normality in two periodic charts. Significant distributions are shown by 22 elements, generally those which react with hydrogen sulfide or diethyldithiocarbamate. Compared to the latter, phosphorodithioic acid, especially when dissolved in the organic phase, is significantly more resistant to decomposition when in contact with strong mineral acid solutions. The effect of chain length and spatial arrangement of the carbon atoms in the alkyl group, of 11 organic solvent systems, and of certain masking agents and diverse salt concentrations on the distribution ratio was investigated. The relative order of extraction (displacement series) of 12 metal complexes was established. (auth)

29041 PARTITION OF PERTECHNETATE ION IN NITRIC ACID WITH DIETHYL ETHER. Moses Attrep, Jr. (Univ. of Arkansas, Fayetteville). Anal. Chem., 34: 1349-50(Sept. 1962).

A procedure for the investigation of partition of the pertechnetate anion into diethyl ether is given. Since close temperature control was not necessary for the extraction condition, all extractions took place at room temperature. The ether layer was evaporated on a planchet and counted. Less than 1 cpm was detected, which indicated a good back extraction. In the region of 0.0 to 6.0 N HNO_3 the extraction coefficient is significantly dependent upon hydrogen ion concentration. Increasing the acidity of the aqueous layer favors protonation of the ether molecule to yield the diethyloxonium ion. In the region of 6.0 to 10.0 N HNO_3, it appears that maximum protonation was obtained, and the partition of the pertechnetate ion is at a relative maximum. (P.C.H.)

29042 STUDIES ON SOLVENT EXTRACTION USING RADIOACTIVE ISOTOPE. X. SOLVENT EXTRACTION OF ZIRCONIUM-95 AND NIOBIUM-95 WITH ACETYLACETONE. Nobuo Suzuki and Takashi Omori (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 35: 595-8(Apr. 1962). (In English)

The extraction of Zr^{95} and Nb^{95} with an acetylacetone–chloroform mixture was investigated. The percentage extraction of Zr^{95} with a 20% acetylacetone solution was 98% at pH values ranging from 3 to 8, and that of Nb^{95} was 90% at pH values from 2 to 5. The extraction ratio of Nb^{95} was lowered by the extension of the shaking time. As a diluent, chloroform and methylene chloride were recommended. Phosphate, oxalic acid, citric acid, and EDTA interfered remarkably. Sulfuric acid was most efficient for the back extraction. A high purity grade of Zr^{95} was obtained by using hydrogen peroxide as a masking agent. The yield was satisfactorily high. (auth)

29043 DECONTAMINATION OF IRRADIATED FUELS BY ELECTROLYSIS IN FUSED SALTS. Jean-Claude Fondanaiche and Tivadar Kikindai. Compt. rend., 255: 285-7(July 9, 1962). (In French)

The problem of the decontamination of irradiated fuels by electrolysis in fused salts was dealt with by means of anodic and cathodic polarization curves. The separation of uranium and a noble metal (molybdenum) yields good decontamination factors. (tr-auth)

29044 EXTRACTION OF TECHNETIUM-99 FROM AQUEOUS SOLUTIONS BY QUINOLINE, TRIBUTYL PHOSPHATE AND CERTAIN OTHER ORGANIC SOLVENTS. I. Spitsyn, A. F. Kuzina, N. N. Zamoshnikova, and T. S. Tagil' (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1066-8(1962). (In Russian)

A number of solvents such as quinoline, TBP, acetone, acetylacetone, thenoyltrifluoroacetone in benzene, and triphenyl guanidine chloride in n-butylalcohol were tested as extracting agents for Tc^{99}. Comparison studies were made with tetraphenyl arsenium chloride and tetraphenyl phosphonium chloride used as complexing agents in extraction tests with chloroform. The purity of the Na pertechnate solutions containing 6 to 8 mg/liter was ascertained by β spectroscopy. The solution was oxidized at room temperature with H_2O_2, than shaken in a speratory funnel with the agent studied; the distribution coefficient was determined radiochemically. For quinoline, this coefficient was high-

est at pH = 8. Reextraction was successfully carried out by adding CCl_3H to the quinoline-water mixture. For TBP the highest distribution coefficient was obtained by adding 0.5 N HNO_3 to the mixture; the complex formed corresponds to $HTcO_4 \cdot 3TBP$. For reextraction 10 to 12 N HNO_3 and 4N NaOH solution were used. Both quinoline and TBP are considered suitable extraction agents for technetium. (TTT)

29045 RADIATION AND CONTAMINATION CONTROL IMPROVEMENTS FOR A PLUTONIUM PROCESSING PLANT. W. L. Marter (E. I. du Pont de Nemours and Co., Aiken, S. C.). Health Phys., 8: 435-8(Aug. 1962).

Methods for the protection of personnel at a new plutonium processing plant at Savannah River by means of improved radiation and contamination control are described. (P.C.H.)

29046 COUNTER-CURRENT EXTRACTION. I. EXTRACTION RESEARCH WITH A MULTI-STAGE 5-CHAMBER PLATE EXTRACTOR. W. J. Ritschard (Union Carbide European Research Associates S.A., Brussels). Helv. Chim. Acta, 45: 1132-7(1962). (In German)

A continuous counter-current extraction apparatus was tested by Jantzen's method with malonic, succinic, and glutaric acid at several flow ratios of the phases, and by a method described by Signer et al. It has a plate efficiency of about 70%. This type of apparatus can be used even when the phases emulsify readily. (auth)

29047 USE OF Di-(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID FOR THE SEPARATION OF THE RARE EARTHS BY REVERSE PHASE PARTITION CHROMATOGRAPHY. T. B. Pierce and P. F. Peck (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 195: 597(Aug. 11, 1962).

A technique is given for the separation of the heavy rare earths Tb through Lu by reverse phase partition using di-(2-ethylhexyl)orthophosphoric acid (HDEHP). Solutions containing 0.05 to 0.5 mg of the irradiated trivalent lanthanides were added to the top of the column in dilute perchloric acid, and the elements were then eluted with perchloric acid of gradually increasing strength at a flow-rate of approximately 2.0 $mg/cm^2/min$. The heavy rare earths, eluted in the order of increasing atomic number. The adjacent rare earths Ce–Pr–Nd, Eu–Gd, Dy–Ho, and Yb–Lu proved somewhat difficult to separate, but good resolution was obtained when the elements were eluted from the column with a slowly changing acid gradient, under the conditions used. (P.C.H.)

29048 IN-LINE RADIOMETRIC PROCESS MONITORS—2. H. Bisby, F. D. Seymour, G. F. Snelling, and J. H. Wilkins (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Power (England), 7: 64-8(Aug. 1962).

Design features are described for an alpha detector and a gamma detector whose purpose is the on-line detection of alpha-emitters (U, Pu, Am, Cm, etc.) and fission products in a radiochemical processing facility for spent reactor fuel. The detectors have a flexible design so as to enable their use in a wide range of activities. (T.F.H.)

29049 PROPOSED AQUEOUS PROCESSES FOR POWER REACTOR FUELS. F. L. Culler, Jr., R. E. Blanco, L. M. Ferris, E. L. Nicholson, R. H. Rainey, and J. Ullmann (Oak Ridge National Lab., Tenn.). Nucleonics, 20: No. 8, 124-7(Aug. 1962).

A summary is presented of proposed aqueous processing methods for various power reactor fuels. Representative examples of the use of these methods are given for several reactor groups. These examples include decladding, core dissolution, and solvent extraction. Features of fuel element which can greatly complicate aqueous processing are described briefly. (D.L.C.)

29050 DIGITAL COMPUTER PROCESSING OF PILOT PLANT DATA. Eugene C. Moncrief and Melvin C. Hill (Oak Ridge National Lab., Tenn.). Preprint Paper No. 48. New York, Engineers Joint Council, 1962. 16p. (ORNL-TM-95)

The use of high-speed data logging and data processing equipment in the Fluoride Volatility Pilot Plant is reported. Data from the Pilot Plant runs are routinely processed and disseminated. Electrical signals received from conventional plant instrumentation are encoded, and the encoded signals are transmitted to the data logger console. Pneumatic signals are received by two pneumatic converters, which ultimately submit an encoded signal to the console. Signals received at the data logger are digitized and punched on paper tape in one of five logging cycles ranging from continuous to 60 minutes. The paper tape output is automatically printed by an on-line teletype for monitoring purposes. The logger output tapes are processed on the Oracle. By coded programs, the Oracle automatically loads the logs and either processes them immediately or stores them indefinitely on magnetic tape. The final step is selection of the means of data dissemination. Oracle output may be photographic curve plots, printed sheet copy of the logs or associated computational programs, or merely as magnetic tape for storage. (L.T.W.)

29051 PREPARATION OF STAINLESS STEEL, ZIRCONIUM, AND GRAPHITE CLAD AND BASE REACTOR FUELS FOR SOLVENT EXTRACTION. R. E. Blanco, L. M. Ferris, and C. D. Watson (Oak Ridge National Lab., Tenn.). Preprint Paper No. 49. New York, Engineers Joint Council, 1962. 39p. (ORNL-TM-131)

Chemical, electrolytic, and mechanical head-end techniques for processing stainless steel, zirconium, and graphite reactor fuel elements are summarized. The Sulfex (sulfuric acid) and Darex (dilute aqua regia) processes for stainless steel-clad ceramic oxide fuels have received extensive laboratory and cold engineering development and shortly will be tested on a plant scale. Modified Darex processes are being developed for Hastelloy-clad UO_2–BeO fuels. Both hydrofluoric acid and Zirflex (NH_4F) processes for zirconium fuels have been improved. Dissolution of zirconium alloy fuels in dilute HF allows processing of fuels containing up to 2% uranium. Alloy fuels containing up to 10% uranium can be processed by the Modified Zirflex method. Alternative methods, Grind-Leach, 90% HNO_3, and combustion-dissolution, for processing graphite-base fuel elements are being studied on a laboratory scale. Supporting studies of the hydrolysis of pure uranium and thorium carbides have also been initiated. Mechanical decladding and chop-leach techniques for several fuel types have been demonstrated. (auth)

29052 PREPARATION OF ALUMINUM-CLAD URANIUM FUELS FOR SOLVENT EXTRACTION. R. I. Martens, W. L. Poe, Jr., and A. E. Wible (E. I. du Pont de Nemours & Co., Aiken, S. C.). Preprint Paper No. 50. New York, Engineers Joint Council, 1962. 29p.

Processes that are used at the Savannah River Plant and at the Hanford Atomic Products Operation to prepare irradiated uranium fuel for solvent extraction processing are described. The fuels are natural uranium or enriched uranium–aluminum alloy, both clad with aluminum. Operations include fuel handling, decladding, dissolving, off-gas

handling, and head-end processing. Experience at Savannah River is emphasized, but experience at Hanford is described where it has been significantly different. (auth)

29053 STATUS OF PYROMETALLURGICAL PROCESSING OF IRRADIATED REACTOR FUELS. M. Levenson (Argonne National Lab., Ill.). Preprint Paper No. 52. New York, Engineers Joint Council, 1962. 14p.

The status of various pyrometallurgical methods of reprocessing irradiated reactor fuels is reviewed. (L.T.W.)

29054 DESIGN PHILOSOPHY FOR A REMOTE MAINTENANCE RADIO-CHEMICAL PROCESSING PLANT. R. J. Christl and A. E. Daking (E. I. Du Pont de Nemours & Co., Wilmington, Del.). Preprint Paper No. 79. New York, Engineers Joint Council, 1962. 33p.

The philosophy of the design of radiochemical separations plants has been explained in numerous publications and the principle of minimum exposure to radioactivity of both on-site and off-site personnel at reasonable capital and operating costs applies more or less equally to any type of processing plant. This paper attempts to summarize the application of this principle to a remote maintenance facility designed for the commercial processing of a variety of irradiated fuels, and represents to a large extent, the results of a recently concluded study sponsored by the Atomic Energy Commission. An effort has been made to include the experiences of various sites in the processing of atomic fuels and the discussion is primarily related to what may be considered to be demonstrated technology. (auth)

29055 DESIGN PHILOSOPHY FOR DIRECT-MAINTENANCE RADIOCHEMICAL PROCESSING PLANTS. J. C. Bresee and J. T. Long (Oak Ridge National Lab., Tenn.). Preprint Paper No. 80. New York, Engineers Joint Council, 1962. 23p. (ORNL-TM-153)

The design philosophy of power reactor fuel processing plants using direct-maintenance techniques is described. In contrast to older comparisons between completely remote and contact-maintained plants, a spectrum of choices is presented within which the engineer may optimize the plant design. Optimum design depends to a considerable extent on a comparison of probable equipment and process life. An estimated probability function for trouble-free plant operation is presented as an example of the required design information. In a discussion of the influence of plant maintenance design on safety, containment criteria and calculation methods are emphasized which can provide acceptable plant safety independent of the maintenance method. Maintenance designs of two new radiochemical plants are discussed briefly. (auth)

29056 DESIGN PHILOSOPHY FOR SMALL-SIZE RADIOCHEMICAL PROCESSING PLANTS. C. M. Slansky and J. A. McBride (Phillips Petroleum Co., Idaho Falls, Idaho). Preprint Paper No. 81. New York, Engineers Joint Council, 1962. 27p.

Small-scale reprocessing plants for nuclear power fuels operating at rates up to 0.3 MTU per day offer certain design features which are radically different from large-scale plants, and which result in savings in investment costs and operating costs that partially offset their small throughput capacity. The process equipment of a small plant is concentrated into a single shielded cell which utilizes space to a maximum and reduces investment costs for shielding, ventilation and air cleaning, pipe galleries, corridors, and remote disconnects. The compact design also reduces building cost, maintenance manpower, and cost of cell decontamination. The small-scale reprocessing plant offers a means whereby private industry can enter the reprocessing of nuclear fuels without a prohibitive investment at a time when small scattered loads of different compositions and enrichments are the main fuel supply. (auth)

29057 SOME COMMENTS ON THE ECONOMICS OF FUEL PROCESSING. V. R. Thayer (E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.) and T. J. Colven. Preprint Paper No. 83. New York, Engineers Joint Council, 1962. 17p.

The economics of aqueous fuel processing is reviewed in the light of a recent Du Pont study of the costs associated with the construction and operation of a large separations plant. The overriding factor in the economics of fuel processing is the availability of sufficient fuel to justify a substantial investment in plant. For the range between 1 and 10 tons of uranium fuel per day, the change in capital cost with design capacity is relatively small so that the means to supply more than adequate capacity should be included in the original design. Comments are given on the effects of fuel types and enrichment on costs. Variations in process and equipment, now under development, that may prove advantageous to the fuel processor are discussed. (auth)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 29222, 29223, 29228, and 29235.

29058 (61GL50) EVALUATION OF BEARING SYSTEMS FOR USE IN SPATIAL ENVIRONMENTS — PHASE III. P. Lewis and S. F. Murray (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Feb. 27, 1961. 98p.

The development and evaluation of bearing and lubrication systems which would operate reliably for extended periods in a spatial environment are discussed. Results are presented from evaluation of fluid lubricants and dry film lubricated ball bearings and sliding tests. The investigation concentrated on the systems concept by considering the following: better definition of bearing performance, techniques to extend life, greater emphasis on sliding contacts, and operation with films and inorganic compounds. It was concluded that grease lubricated bearing systems are promising for extended life at full evaporating conditions and radiation to 10^5 rads. Shields were found to offer promise for reducing the evaporation losses. A few solid films showed promise as lubricants in rolling contact bearings. The use of gallium–indium eutectic film as a supplementary lubricant appeared to be very beneficial in extending the life and performance of these solid films. Composite bearing materials, containing a solid lubricant in the structure, showed the most promise for sliding bearing materials. (auth)

29059 (HW-69432(Suppl.A)) PERFORMANCE TEST RESULTS REMOTELY OPERATED TUBE CLOSURE DEVICE. K. S. Hawkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 2, 1962. Contract AT(45-1)-1350. 13p.

The development testing of ball and flapper caps is discussed. The Mark VI flapper caps demonstrated their effectiveness, and seals for these caps gave suitable on-reactor service in excess of one year. The ball caps, however, showed the necessity for further development effort. Of prime importance was the reduction of the pulling force required to open the ball caps with the actuator during operation, and manually during shutdown. (M.C.G.)

29060 (NASA-TN-D-1217) HIGH-VACUUM CONDENSER DESIGN: EXPERIMENTAL EFFECTS FROM CESIUM AND MERCURY ION BEAMS. Edward A. Richley and Ronald J. Cybulski (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1962. 33p.

Effects of variable-energy electrostatic rocket-engine ion exhaust beams that pertain to the design of high-vacuum condensers are discussed. Three ion-engine beam sources, using Cs and Hg as propellants, were operated at energy levels of 200 to 9000 ev and currents of 0.002 to 0.200 amp. Five condenser geometries, having surface areas from 0.267 to 5.76 m^2, were tested. Values for a function of the accommodation and condensation coefficients, which appear in an existing theoretical analysis, were determined. Although exhibiting rather wide variations in some tests, the values were estimated at approximately 0.15 for Cs and 0.015 for Hg. A method of estimating condenser surface area requirements is given. (auth)

29061 (NYO-9809) ULTRAHIGH VACUUM TECHNIQUES. Annual Report, January 1–December 31, 1961. Research Report 62-808-441-R2. R. E. Fox, W. J. Lange, and J. H. Singleton (Westinghouse Electric Corp. Research Labs., Pittsburgh). Mar. 21, 1962. Contract AT(30-1)-2823. 39p.

Activities in an investigation of basic phenomena associated with particle interactions at surfaces are reported. Development of components, which may be of interest to others working in ultrahigh vacuum research, for use in the research program is described. Work in development of components and techniques was directed toward investigations of non-refrigerated traps, a cryogenic pump using liquid He, and development of electron sources. Research on interaction of particles at surfaces was devoted to photodesorption studies, O adsorption on W, and H interaction with system walls. The study of basic phenomena limiting the attainment of ultrahigh vacuums is being approached by mass spectrometric studies, negative ion formation in H and H_2O, and outgassing of stainless steel systems. (J.R.D.)

29062 (TID-11279(Suppl.)) THEORY AND DESIGN DATA FOR CONTINUOUS FILM, SELF-ACTING JOURNAL BEARINGS OF FINITE LENGTH. Interim Report. Harold G. Elrod, Jr. and Stanley B. Malanoski (Franklin Inst. Labs. for Research and Development, Philadelphia). June 1962. Contract Nonr 2342(00). 47p. (I-A2049-17; I-A2049-13 (Suppl.))

Charts are presented for the design of complete film, self-acting journal bearings, operating under steady state conditions, and using either liquids, vapors or gases. The application of the charts is illustrated by several examples. These charts represent the load coefficient, C_L, in a normalized fashion so as to retain accuracy over all ranges of L/D, A, and ϵ. Curves for the attitude angle, ϕ, are also included. Performance relations for this type of bearing are summarized. In order to complete the design charts, two analyses for the limiting cases of the short bearing and the heavily loaded bearing were developed. (auth)

29063 (TID-16020) REPORT ON GLOVE BOXES AND CONTAINMENT ENCLOSURES. Nelson B. Garden, ed. (Ad Hoc Committee on Glove Boxes). June 20, 1962. 147p.

Criteria and guide lines are presented for the design, construction, and operation of safe, economical, and efficient glove boxes and associated facilities based upon present conditions and anticipated changes. Comprehensive discussion of glove box materials and components, safety and fire prevention methods, health physics problems, operational considerations, and brief descriptions of AEC installations are included. (39 references) (C.H.)

29064 (TID-16353) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED TURBOMACHINERY. Quarterly Technical Report, March 1, 1962–May 31, 1962. D. D. Fuller, M. W. Eusepi, and E. J. Gunter (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 39p.

Progress in developing a practical gas-lubricated bearing for use in high-speed turbo machinery is reported. Two separate bearing systems were designed and analyzed; one requiring external pressurization, and the other of a self acting nature. Because of stability problems frequently encountered in 360° journal bearings, particularly gas lubricated bearings, attention was directed toward the development of pivoted pad self acting bearings. This bearing arrangement is inherently more stable than the conventional full journal bearing. The experimental work performed on

both the self acting (SA-2) and the externally pressurized (EP-2) rotors is described. Extensive static tests of the stability regions and of the characteristics of the combination thrust-journal bearing of the EP-2 rotor were conducted. The rotor is being balanced and prepared for dynamic testing. The SA-2 rotor was successfully run over speeds of 20,000 rpm with the narrow (aspect ratio = 1) pivoted pad shoes. No instability regions were encountered in any range of the operating speed. Indirect film thicknesses at the various speeds were obtained. At present the shoes are being modified to hold the capacitance probes so as to permit direct film measurements. A theoretical analysis of the tilting pad shoes is being run concurrently with the experimental work on the self acting rig. This analysis, which utilizes the high speed digital computer, will be able to predict the behavior of tilting-pad journal bearings of finite length with a compressible lubricant. The film thicknesses obtained from this program will be compared to the experimental values obtained. (auth)

29065 (VUP-2401) SHOCK SPECTRUM MEASUREMENTS. Preliminary Report — Project 1.7. M. V. Barton and J. M. Lindahl (Space Technology Labs., Inc., Redondo Beach, Calif.). June 1962. Project GNOME. 29p.

A total of twelve reed gages were installed for horizontal and vertical displacement shock spectrum measurements on the GNOME event. Seven of the twelve reed gages were placed on the earth's surface at various ranges from surface zero. Four of the gages were placed in the GNOME tunnel. One gage was placed in a mine approximately nine miles from the GNOME site. Usable data were obtained from nine of the ten records recovered to date. The gage in the mine recorded no displacements. Records from the gages in tunnel nearest zero have not been recovered. (auth)

29066 (WAPD-256) A NUMERICAL SOLUTION FOR PLANE ELASTICITY PROBLEMS. D. S. Griffin and R. S. Varga (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1962. Contract AT(11-1)-Gen-14. 44p.

A method is presented for obtaining the stresses in a plane caused by a temperature field, body forces, and boundary forces. The method, based on finite differences, makes efficient use of the digital computer in solving for the irregular boundary shapes often encountered in engineering design. A numerical example shows its application to a notched tension member. (auth)

29067 (AEC-tr-5255) THEORY OF PULSED EXTRACTION COLUMNS. A. M. Rozen. Translated from Nauch. Doklady Vysshei Shkoly., Energet., No. 3: 173-86(1958). 16p.

An attempt was made to establish a connection between the pulsation intensity, I, and the droplet radius, R, of pulsed extraction columns by using theoretical considerations and collected data. The hold-up, Ω, and mass transfer coefficient, k, which in the first approximation are functions of the droplet radius, were determined from hydrodynamic and mass transfer equations. The effect of pulsation in general and its components in particular were characterized by efficiency factors. (M.C.G.)

29068 (AEC-tr-5279) THE IMAGE CHARACTERISTICS OF A MAGNETIC SECTOR FIELD WITH CONSIDERATION OF THE STRAY FIELDS. L. A. Koenig and H. Hintenberger. Translated from Z. Naturforsch., 10a: 877-86(1955). 24p.

A theoretical treatment is presented for the image characteristics of magnetic sector fields with a consideration of the stray fields for ionic beams in the central plane of the fields. Expressions are given for the dispersion and spherical aberration of magnetic sector fields with linear and curved field boundaries. Several examples were calculated in which the boundaries between the homogeneous field part and the stray field were assumed to be at the section $|Z_s| = 1.5$ k inside the edge of the pole piece and parallel to it; while for measured magnets the boundaries of the homogeneous substitute field that would lead to the same image as the real field were taken about the distance $Z_s = 2.1$ k outside the edge of the pole piece. (M.C.G.)

29069 (UCRL-Trans-846) REQUEST FOR A PATENT FOR A LABORATORY EVAPORATOR AT A CONSTANT LEVEL, USING THE SURFACE TENSION OF THE LIQUID TO BE EVAPORATED. E. de Robien (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Grenoble). Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from report CEA-Note-INT/SPR/62-298. Apr. 13, 1962. 16p.

A device is described in a patent application for a constant level evaporator which is designed to use the surface tension of the liquid to be evaporated to obtain a constant level in the evaporation cupel. The device features automatic heat shut-off at the end of evaporation, and a system of anti-embolism. (J.R.D.)

29070 NEW HORIZONS IN RESOURCE DEVELOPMENT. THE ROLE OF NUCLEAR EXPLOSIONS. W. N. Hess (Univ. of California, Livermore). Geograph. Rev., 52: 1-24(Jan. 1962). (UCRL-6360)

Experience gained with underground explosions, both contained and cratering, is discussed. Safety problems and cost of nuclear explosions are considered briefly. Possible applications of underground nuclear explosions are discussed in some detail, particularly in excavation projects (harbors, canals, and removal of obstacles to navigation), mining, development of water resources, oil production, and power production. (D.L.C.)

29071 METHOD OF PREPARING SOURCES FOR BETA SPECTROMETERS. Jacques Valentin (Laboratoire Joliot-Curie, Orsay, France). Rev. Sci. Instr., 33: 869(Aug. 1962).

A method is described for depositing activity on the front side only of thin wires for use as very narrow sources in beta spectrometers. In the method, a small droplet of the solution containing the activity is placed on a Teflon pedestal in a glove box, and the wire is mounted in a horizontal position just over the pedestal. By means of a screw and a micromanipulator, the wire and drop are scarcely brought together so that one side of the wire snaps up the drop by surface tension. The wire is then heated by a-c to evaporate the drop while undergoing a horizontal back-and-forth motion in order to make a very uniform source. (D.L.C.)

29072 HIGH VACUUM BRASS-TO-ALUMINUM SEAL FOR USE AT CRYOGENIC TEMPERATURES. P. P. Craig, W. A. Steyert, and R. D. Taylor (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 33: 869-70(Aug. 1962). (LADC-5317)

A seal is designed for the thin Al windows in a helium cryostat made from brass. The seal comprises a brass collar soldered into the cryostat bottom, an O-ring made from a soft alloy and fitting loosely around the collar, and an Al retainer on the thin window. The retainer is slipped over the collar and O-ring and compressed by means of a brass or phosphorus bronze clamp ring. The retainer is formed with a lip to transfer thermal stresses from the window to the neck of the retainer. The seal improves at low temperatures owing to differential contraction of Al

with respect to brass. The window is preferably made out of Type 6061 Dural and should be annealed after machining. (D.L.C.)

29073 TRANSISTORS FOR AVALANCHE-MODE OPERATION. Harold W. Miller and Quentin A. Kerns (Univ. of California, Berkeley). Rev. Sci. Instr., 33: 877-8(Aug. 1962).

Selected Motorola transistors of the MM-486, -487, and -488 type were found to be useful for avalanche-mode operation. A circuit for selecting avalanche units is described. Ten to 30% of the transistors usually will avalanche. The time delay between the trigger pulse and the rise of the avalanche current is discussed. (D.L.C.)

29074 LARGE HYDROGEN CONDENSATION PUMPS FOR ULTRAHIGH VACUUM. E. S. Borovik, B. G. Lazarev, and I. V. Mikgailov. Vide, 17: 231-9(May-June 1962). (In English)

Experimental investigations of two types of liquid hydrogen condensation pumps, a vacuum system based on a trap cooled to 20°K, were reviewed. An evaluation of large hydrogen condensation pumps is made by consideration of methods to use the very low temperature hydrogen vapor. The testing technique and measurement of the hydrogen evaporation rate are described. (J.S.R.)

29075 STUDY AND CONSTRUCTION OF A TITANIUM PUMP. J. Sarrau (Université Caen, France). Vide, 17: 267-72(May-June 1962). (In French)

This high vacuum pumping unit includes a conventional diffusion pump backed by a mechanical pump and topped with a freon trap. The titanium pump located above this trap has a volume of 20 liters. The high vacuum part proper has a volume of 45 liters. All gaskets are neoprene O rings. The titanium pump is of the "continuous evaporation" type and is switched on when the pressure is below 10^{-5} torr. The pressure in the main chamber is below 10^{-7} torr after 2 hours pumping. (auth)

29076 PROSPECTS OF NUCLEAR POWER IN PAKISTAN. Report of a Mission sent to Pakistan by the International Atomic Energy Agency. (International Atomic Energy Agency, Vienna). Technical Reports Series No. 7. June 1962. 54p. (STI/DOC/10/7). $1.00(IAEA).

The long-term power requirements in Pakistan are reviewed, and cost estimates are presented for conventional and nuclear power alternatives in various areas of the country. Comments regarding the types of power reactors best suited for use in Pakistan are included and fuel availability is examined. The prospects of nuclear power in Pakistan are summarized and benefits associated with the first nuclear plant are discussed. (J.R.D.)

29077 ELECTROMAGNETIC WAVEGUIDES AND CAVITIES. Georg Goubau. Physics and Technology. Volume 5. New York, Pergamon Press, 1961. 672p. $13.50. Translated from "Elektromagnetische Wellenleiter und Hohlrïume. Physik und Technik. Band 5." Stuttgart, Wissenschaftliche Verlagsgesellschaft M. B. H., 1955. 470p. (AEC-tr-3926)

Electromagnetic waveguides and cavities and their combination to microwave circuits are discussed. Maxwells' field theory of electromagnetic waveguides is outlined. Only "screened-off" or "closed" waveguides were included in the treatment. Fields inside cavities with metallic boundaries were considered. A foundation was established for the network theory of cavity systems. The theory of networks composed of elements interconnected by tubular or concentric lines is discussed. Such network elements can be treated as 2n-poles and characterized by impedances, if appropriate definitions for current and voltage are introduced. The excitation problem and the perturbation theory for cavities are discussed. (M.C.G.)

29078 MATERIALS AND RATINGS FOR DRY-RUNNING GEARS. H. J. Watson (David Brown Industries Ltd., Huddersfield, Eng.). Preprint Paper No. 1. London, The Institution of Mechanical Engineers, 1962. 8p.

The requirements of nuclear power stations have led to the development of gears intended to transmit measurable power when running dry. For some applications a restriction on the use of a range of metals promoted an investigation into non-metallic materials. Such requirements tended to encourage the design of gears possessing a low power rating owing to difficulties connected with adequate heat dissipation. Experimental work necessary to determine a satisfactory material combination for worm gears operating without lubrication is described for discs and gears. Further experimental results on work undertaken to meet industrial requirements for spur gears running with a dry lubricant are reported and the limitations of the materials used are shown. The effect of different surface treatments applied to gear-tooth flanks was investigated and findings are described. A comparison made between the Novikov and involute tooth forms on double helical gears running dry showed the latter to be superior for wear resistance under the test conditions used. Practical methods of establishing permissible rating criteria are described. (auth)

29079 UNLUBRICATED METALS AS BEARINGS FOR CARBON-DIOXIDE-COOLED NUCLEAR REACTORS. H. H. Heath and K. F. Phillips (English Electric Co., Ltd., Whetstone, Eng.). Preprint Paper No. 2. London, The Institution of Mechanical Engineers, 1962. 8p.

Metals with a cold hardness of 700 Vickers pyramid number or greater were found the most successful when run as unlubricated bearings. Considerable difference was found between wear behavior in carbon dioxide and in oxygen-rich atmospheres. The wear of soft steels may be improved by the presence of oxide embedded in the surface. Strong adhesion can occur when certain iron-based materials are left in stationary contact at elevated temperature. Methods of reducing this tendency were found. Rough, particularly sand-blasted, surfaces suffer less from scoring and have less tendency to stick-slip than lapped surfaces. (auth)

29080 FRICTION AND WEAR BEHAVIOUR OF POSSIBLE BEARING MATERIALS IN HIGH-PURITY LIQUID SODIUM AT TEMPERATURES UP TO 500°C. W. H. Roberts (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). Preprint Paper No. 3. London, The Institution of Mechanical Engineers, 1962. 10p.

A crossed-cylinder apparatus is described which enables basic friction and wear data for materials immersed in liquid metals to be obtained. Results are presented for a selection of chromium alloys rubbed under boundary lubrication conditions in high-purity sodium in the temperature range 200 to 500°C. The behavior of these combinations is compared with that in gases (carbon dioxide and helium), under corresponding conditions of load, rubbing speed, and temperature. Friction coefficients and wear rates were generally lower in sodium, implying that the liquid metal provides a measure of lubrication between the rubbing surfaces. A striking feature of the results in sodium is the manner in which wear rate increased fairly regularly with increasing temperature for all the rubbing combinations examined. This behavior is in complete contrast to that in carbon dioxide and helium, where the wear-temperature curves varied markedly for

different combinations. Experiments are described which were aimed at establishing that hydrodynamic lubrication did not materially contribute to the observed effects in sodium. (auth)

29081 LUBRICATING PROPERTIES OF FIRE-RESISTANT FLUIDS. S. F. Chisholm (Mobil Oil Co. Ltd., London). Preprint Paper No. 4. London, The Institution of Mechanical Engineers, 1962. 7p.

Requirements for a fire-resistant lubricant are described briefly. The following types of fire-resistant fluids are considered: water-base synthetic fluids (e.g., water-glycol), non-aqueous fluids (phosphate esters, chlorinated phosphate esters, and chlorinated hydrocarbons), and water-in-oil emulsions. The following properties of these fluids are discussed: flow properties, stability, wear protection, fire resistance, environmental compatibility, toxicity, and service characteristics. (D.L.C.)

29082 AIR-LUBRICATED JOURNAL BEARINGS AT HIGH COMPRESSIBILITY NUMBERS. J. Kerr (National Engineering Lab., East Kilbride, Eng.). Preprint Paper No. 5. London, The Institution of Mechanical Engineers, 1962. 8p.

An experimental investigation of induced pressure (hydrodynamic type) air-lubricated plain journal bearings operating at high speeds and sustaining steady loads is described. Air-film thickness measurements are reported and the experimental results are compared with available theoretical predictions. The theoretical non-dimensional parameter Λ, usually called the compressibility number, is used as the basis of comparison. Results are given for bearings with a breadth/diameter ratio of unity and journal diameter of 1 in. approximately. These were used for all the experiments and a range of Λ from 6 to 12 was achieved principally by changes in speed from 30000 rpm to 80000 rpm and radial clearance from 0.00038 in. to 0.00063 in. The experiments confirm the important theoretical prediction for compressible fluids that at any eccentricity ratio when $\Lambda > 6$ the load carried by a bearing of this type is nearly independent of change in speed and clearance. The experimental values for load were smaller in all cases than those predicted by a number of theories: Ausman's analytical results published in 1960 provide the closest agreement in this region. His equations have therefore been calculated and plotted to provide an approximate design procedure. Departures from theory are discussed and it is shown that the factor load × minimum film thickness remains constant in this same range of Λ within the limits of experimental error. The effect of compressibility is discussed with particular reference to displacements occurring normal to the load line and consequent variations in stability under conditions of dynamic loading. (auth)

29083 HYDRODYNAMIC GAS-LUBRICATED BEARINGS. J. R. W. Block and J. D. Braithwaite (D. Napier and Son Ltd, Acton, Eng.). Preprint Paper No. 7. London, The Institution of Mechanical Engineers, 1962. 9p.

Investigations were conducted on the performance of the hydrodynamic journal bearing under various operating conditions and design factors, on the resistance of various journal and bush materials to starting and stopping wear, and on the performance of a thrust bearing. (D.L.C.)

Heat Transfer and Fluid Flow

Refer also to abstracts 30008 and 30039.

29084 (AROD-1540.6) RESEARCH AND DEVELOPMENT WITH RESPECT TO HEAT TRANSFER IN QUENCHING. Final Report, December 16, 1955 to December 15, 1961. V. Paschkis and George Stolz, Jr. (Columbia Univ., New York). July 1962. Contract DA-30-069-ORD-1621. 50p.

Heat transfer coefficients were determined in quenching. Samples were heated and quenched under controlled conditions. Thermocouples were used to record the temperature at several points in the sample on an oscillograph. From the cooling curves, surface heat flux and surface temperature were computed as a function of time. Results are reported as heat flux or heat transfer coefficient vs. surface temperature. Samples, instrumentation, apparatus, oscillogram reader, evaluations, oil quenching experiments, effects of surface conditions, aqueous quenching experiments, and theoretical aspects are discussed. (M.C.G.)

29085 (KAPL-2208) HYDRODYNAMIC STABILITY OF A BOILING CHANNEL. PART 2. A. B. Jones and D. G. Dight (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 20, 1962. Contract W-31-109-eng-52. 87p.

STABLE-3 is an extension of the STABLE-2 Philco 2000 digital computer program for examining the hydraulic stability of a single boiling coolant channel in parallel with many other channels. Only the modifications of STABLE-2 resulting in the program called STABLE-3 are discussed. The modifications were made primarily to simplify the input-output effort required of the user, to minimize the magnitude of a discontinuity occurring in a certain friction factor correlation, and to approximately accommodate the simultaneous existence of both nonboiling and subcooled boiling regimes in the subcooled region of the coolant channel. A program listing and instructions for running the program are included. (auth)

29086 (NP-11845) THE TRANSITION FROM TWO PHASE BUBBLE FLOW TO SLUG FLOW. Report No. 7-7673-22. Technical Report No. 22. Nick A. Radovcich and Raphael Moissis (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). June 1962. Contract NONR-1841(39). 81p.

The process of transition from bubble to slug flow in a vertical pipe was studied analytically and experimentally. An equation is presented which gives the agglomeration time as a function of void fraction, channel diameter, initial bubble diameter, and liquid purity. A dependent function which also appears in the equation was evaluated using experimental data. A reasonably good correlation of the data was achieved. (auth)

29087 (NYO-10093) TWO PHASE FLOW THROUGH A VERTICAL VENTURI. Topical Report No. 4. Report No. 321. Raphael Moissis and Nick A. Radovcich (Dynatech Corp., Cambridge, Mass.). July 24, 1962. Contract AT (30-1)-2907. 24p.

An analytic model is proposed for evaluating slip velocity effects in the flow of a two-phase mixture through a vertical venturi. The model allows for a flow regime transition to take place between venturi inlet and throat. Experiments performed in an air-water system were correlated by means of the proposed model to a good accuracy. (auth)

29088 (TID-12426) BOUNDARY LAYER IN THERMAL RADIATION ABSORBING AND EMITTING MEDIA. R. Viskanta and R. J. Grosh (Argonne National Lab., Ill.). Feb. 1961. Contract [W-31-109-eng-38]. 16p. (UAC-5012)

A boundary layer problem concerned with the effects of incident thermal radiation upon absorbing and emitting media flowing over a wedge was considered. The general boundary layer problem was formulated in terms of an equation of transfer for thermal radiation, a nonlinear

integro-differential equation which represents conservation of energy, and the usual equations for conservation of mass and momentum. Because no general solution for these equations is possible, the Rosseland approximation for the radiant heat flux vector is used to make the energy equation solvable. Numerical solutions for heat transfer and the temperature distribution in the wedge boundary layer are given. Calculations are presented for a fluid whose Prandtl number is one, as well as for molten Pyrex glass. (auth)

29089 (AEC-tr-5310) PRELIMINARY DESIGN FOR A TEST-COMPONENT LOOP WITH LIQUID SODIUM AT ELEVATED TEMPERATURE. P. Colombo (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratorio Ingegneria e Servomeccanismi Reattori, Ispra). Translated for Oak Ridge National Lab., Tenn. [1962]. 12p.

The liquid sodium loop and its principal components are described. The loop will permit operating experience to be acquired on liquid metal systems, particularly with regard to their manipulation and control of oxide content, and will furnish principles for the evaluation of the behavior of the components and the instrumentation. The loop (with a maximum temperature of 770°C) essentially consists of a hot section supplied by a 50 kw resistance heater and a cold section in which the heat supplied by the heater in the loop is dissipated by a sodium-air exchanger. The loop also contains two dismountable test sections for evaluating components in liquid sodium. The system will be connected to a sodium melting furnace and will be equipped with an auxiliary inert gas system (argon or helium). (N.W.R.)

29090 (AEC-tr-5330) EXPERIENCE WITH EXPERIMENTAL SODIUM HEAT TRANSFER CYCLE. Miroslav Pasek. Translated for Oak Ridge National Lab., Tenn. from Jaderna energie, 8: 43-50(1962). 26p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11834.

29091 (FTD-TT-62-380) THE EFFECT OF VARIABLE HEAT FLOW ALONG THE SURFACE OF A PIPE ON HEAT TRANSFER WITH TURBULENT FLOW. G. S. Ambrok. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 7, 19-24(1961). 8p.

An analysis of variable heat flow effects on transfer with turbulent flow in pipes is presented. The Prandtl formula is used in a calculation procedure for random continuous distribution of the thermal load. It was found that variable heat flow along a pipe, compared with constant heat flow, has no appreciable effects on the average values of the heat-transfer coefficients with turbulent flow in pipes. (J.R.D.)

29092 (FTD-TT-62-714) A STUDY OF HEAT ABSORPTION BY LIQUID METAL IN A CHANNEL OF RECTANGULAR CROSS SECTION. V. I. Subbotin, S. P. Kaznovskii (Kaznovskiy), and V. I. Sidorov. Translated from Teploenergetika, No. 9, 68-72(1961). 15p.

Special features of heat absorption by liquid metal are considered. Models with flat fuel elements are used in the study. Results are included concerning heat transfer to Hg in a rectangular cross-section channel. (J.R.D.)

29093 GAS BLOWERS FOR DUNGENESS. T. E. Adams. AEI (Assoc. Elec. Ind.) Eng., 2: No. 4, 166-73 (July–Aug. 1962).

The design of gas blowers for circulating CO_2 through the reactor and heat exchangers at the Dungeness nuclear power station is described. The blowers will have spherical rather than cylindrical outer casings. Among the items discussed are casing aerodynamic losses, blading, casing stresses, stator and rotor design, Hirth coupling, and seals. (D.L.C.)

29094 THE VELOCITY OF RISE OF SINGLE CYLINDRICAL AIR BUBBLES THROUGH LIQUIDS CONTAINED IN VERTICAL TUBES. E. T. White and R. H. Beardmore (Univ. of Queensland, Brisbane). Chem. Eng. Sci., 17: 351-61(May 1962). (In English)

Velocity measurements were made on single cylindrical air bubbles rising in a variety of liquids contained in vertically mounted tubes sealed at the lower end. A general graphical correlation involving $Fr = u^2/gd$, $Eo = \rho g d^2/\sigma$ and $Y = g\mu^4/\rho\sigma^3$ is given. It is shown that viscous effects are of minor importance if $\rho^3 g d^3/\mu^2 > 3 \times 10^5$, interfacial effects if $Eo > 70$, and inertial if $Fr < 0.003$. Evidence suggests that the general correlation is also applicable to limiting velocity data for smaller (non-cylindrical) bubbles. (auth)

29095 CORRELATION FOR TWO-PHASE FLOW. John F. Marchaterre and Barton M. Hoglund (Argonne National Lab., Ill.). Nucleonics, 20: No. 8, 142(Aug. 1962).

A correlation is presented which can be used for predicting vapor-liquid velocity ratios and thus the vapor volume fraction in a vertical channel in a boiling water reactor. The correlation is based on the equation $V_g/V_l = [X/(1-X)][(1-\alpha)/\alpha]\,\rho_l/\rho_g$, where V_g, V_l = local velocity of gas and liquid phases, relatively; X = gas/total weight flow rate ratio; α = gas/total volume fraction; and ρ = density. The correlation holds only for superficial velocities >0.8 ft/sec and for the region beyond local boiling. The correlation is compared with the data of various investigators. (D.L.C.)

Instrumentation

Refer also to abstracts 29243, 29492, and 30011.

29096 (AEDC-TDR-62-161) STUDY OF INSTRUMENTATION FOR A SPACE SIMULATION CHAMBER. H. R. Farrah, R. A. Fluegge, J. M. LaRue, T. J. Mohan, F. W. Poblenz, and W. G. Wolber (Bendix Corp. Research Labs. Div., Southfield, Mich.). Aug. 1962. Contract AF40 (600)-955. 329p.

The information obtained through a study of the instrumentation and data collection of pertinent parameters in a large ultra-high vacuum aerospace chamber is documented. Existing techniques for the measurement of cryogenic temperature, residual gas pressure, solar and planetary radiation, composition, and density were evaluated. Methods of modifying, designing, or developing sensing devices to make them suitable for use in an aerospace chamber were studied. (auth)

29097 (AERE-R-3990) THE LOW ACTIVITY COUNTING EQUIPMENT IN USE AT WOOLWICH OUTSTATION, U.K.A.E.A. (RESEARCH GROUP), 1956-61. J. L. Waddingham (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Apr. 1962. 20p.

Standard equipment used for the automatic counting of low beta-active sources is described along with development carried out to provide counting facilities at the lowest level for human bone analysis. Background counting rates and stabilities of 0.6 ± 0.025 counts/min are normal over periods of months, with efficiencies (for Y^{90}) in the region of 25%. Two types of alpha counter (flow and scintillation) are briefly described for which approximate background counting rates and efficiencies of 1 count/hour (45%) and 3 counts/hour (30%) respectively are experienced. (auth)

29098 (AWRE-NR/P-3/62) VERY LOW BACKGROUND PROPORTIONAL COUNTER ASSEMBLIES. D. Ramsden (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1962. 29p.

Design features are described of very low background proportional counter assemblies for use in C^{14} dating. For an optimum background a large screen wall counter was used in the low-level tank in conjunction with boron wax shielding. For higher activity samples where 24-hr counting runs are used, a plastic phosphor counter gave sufficient accuracy. (C.H.)

29099 (CEX-60.3) EXTENDED AND POINT SOURCE RADIOMETRIC PROGRAM. F. J. Davis and P. W. Reinhardt, eds. (Oak Ridge National Lab., Tenn. and Division of Biology and Medicine, AEC). Mar. 1962. Contract [W-7405-Eng-26]. 93p.

An extended-source calibration area was set up in the Nevada Test Site area to encourage a standardization of airborne radiometric instrumentation among several government agencies and private companies. A simulated plane-source array was laid out with positions at 100-ft intervals in the form of a square 2000 ft on a side. For gound measurements a smaller square array of 100 positions at 10-ft intervals was placed in the center of the large array. Two sets of sources were used in the array. Co^{60} and Cs^{137} sources of 4.5 and 15 mc, respectively, were available for the large array and sources one hundredth of these values in the smaller array. Point sources of Co^{60}, Cs^{137}, and I^{131} of the order of 2 curies each were available for comparison with the area sources. Measurements 3 ft above the area sources indicated 200 μr/hr for Co^{60} and 225 μr/hr for Cs^{137}. Four government agencies and one private company participated in an intercalibration exercise. Various types and sizes of aircraft from a Cessna 172 to a Douglas DC-3 were used. Various instrumentation devices, mostly scintillation type detectors, were tested. Flights ranging from 100- to 1000-ft altitude included background measurements, instrument calibration, intercalibration, proof-testing equipment, comparison of point- and area-source measurements, measurements of air attenuation and buildup of gamma radiation, and gamma-ray spectral measurements. (auth)

29100 (HASL-129) FILTERS TO PROVIDE NEARLY MONOENERGETIC X-RAYS. Arthur Shambon and Daniel Murnick (New York Operations Office. Health and Safety Lab., AEC). July 1962. 18p.

Four filters for use with a 250-kvp pulsating x-ray machine were constructed to calibrate radiation detection instruments in the energy region below 200 kev. Approximately monoenergetic beams of 63, 105, 150 and 180 kev were produced. The spectral distribution was computed using the formula of Kulenkampff. The energies were found to drop rapidly from the peak values. The average values were checked from absorption curves obtained experimentally and found to deviate from the computed peak values by 10%. (auth)

29101 (HW-73994) A WELL WATER TEMPERATURE LOGGING SYSTEM. J. R. Raymond (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 5, 1962. Contract AT(45-1)-1350. 12p.

A system was designed and fabricated to measure and record well water temperatures at depth. The instrument consists of a thermistor sensing probe, electrical wire line, measuring circuitry, power driven cable reel, and a recorder. Temperature range of the equipment is 10 to 80°C. Day to day accuracy is about ±0.2°C and sensitivity is 0.1°C. Maximum operable depth is 800 feet below water surface. Operational experience proved that the system is reliable and easy to operate and maintain. (auth)

29102 (HW-SA-1993) A LIQUID NITROGEN LEVEL CONTROLLER. I. T. Myers and L. C. Davenport (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 3p.

A liquid nitrogen level controller that graphically indicates the nitrogen level and operates by resistance changes between room and cryogenic temperatures of a ten foot length of #30 copper wire closewound into a ½ inch diameter coil is described. (N.W.R.)

29103 (IS-212) AN ELECTRICAL PASS-THROUGH FOR CLEAN, HIGH VACUUM USE. Don M. Jackson, Garry Wells, and Donald Soseman (Ames Lab., Ames, Iowa). [Sept. 20, 1960]. Contract [W-7405-eng-82]. 6p.

A mechanical seal for a high-voltage, vacuum pass-through is described for use in a general utility 60° sector mass spectrometer. The vacuum seal was achieved through the use of a specially designed steel ring which has knife edges machined around the center portion of both faces. (N.W.R.)

29104 (JEN-96-DF/I-29) CÁMARA DE IONIZACIÓN CON REJA. (Gridded Ionization Chamber). F. Manero Amoros (Spain. Junta de Energia Nuclear, Madrid). 1962. 27p.

The working principles of a gridded ionization chamber are given, and all the different factors that determine its resolution power are analyzed. One of these devices, built in the Physics Division of the J.E.N., and designed specially for use in measurements of alpha spectroscopy, is described. Finally the main applications, in which the chamber can be used, are shown. (auth)

29105 (JINR-P-897) BYSTRODEISTVUYUSHCHIE PERESCHENTNYE NAKOPITEL' NYE SKHEMY. (Rapid Scaling Storage Circuits). V. M. Lachinov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 10p.

Scaling storage circuits having the scaling ratios 2 and 5 developed to be used as broadband scaling pulse repetition frequency circuits are described. The maximum rate of the scaling storage circuit with the scaling ratio 2 is 150 Mc/s, the minimum is ~4 Mc/s. The scaling circuit with the scaling ratio 5 has the band from ~80 up to ~1 Mc/s. The series-connected circuits provide for the decade repetition rate scaling of the input pulses. (auth)

29106 (LA-2717) A NEUTRON MONITORING INSTRUMENT HAVING A RESPONSE APPROXIMATELY PROPORTIONAL TO THE DOSE RATE FROM THERMAL TO 7.0 Mev. Dale E. Hankins (Los Alamos Scientific Lab., N. Mex.). Mar. 1962. Contract W-7405-eng-36. 20p.

This report describes a neutron detection instrument that has a response approximately proportional to the dose rate of neutrons with energies from thermal to 7.0 Mev. The instrument responds to thermal neutron energies within ±4 per cent and to fast neutron energies within ±15 per cent of the actual dose rate. Readings for intermediate range neutrons result in an overestimation that may be as high as a factor of 2.8 for a 1/E scattered spectrum. This error is reduced when the thermal and fast neutron dose rate is added, and at the Los Alamos Scientific Laboratory the observed overestimate of the total dose rate varies up to a maximum of 65 per cent. The use of this instrument to monitor neutron fluxes of unknown energy and spectrum gives an indicated dose rate that is ordinarily much more accurate than that obtained

with thermal and fast neutron monitoring instruments presently in use at Los Alamos. In circumstances where the scattered or intermediate energy neutrons contribute significantly to the total dose, this instrument is the only one known by the author which with reasonable accuracy detects and evaluates the dose rate with no assumptions or calculations required. (auth)

29107 (NEVIS-106) GATED FREQUENCY DIVIDING CIRCUIT FOR IMPROVED RESOLUTION IN DIGITAL TIME INTERVAL MEASUREMENTS. Walter O. Lecroy, Jr. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). [1960?]. Contracts AT-30-1-GEN-72 and Nonr-266(72). 13p. (R-324; CU-213)

A circuit technique for eliminating the one cycle uncertainty that normally exists in a time interval measurement made by counting the number of cycles of a crystal oscillator that occur between "start" and "stop" pulses is described. A high frequency crystal oscillator is used in conjunction with a gatable frequency dividing circuit (described in detail) to yield a train of highly stable timing pulses that begins in phase with the "start" pulse. The technique is useful in the frequency range from one to several hundred Mc, and can be extended above 1 kMc. (auth)

29108 (NP-11949) FAILSAFE CIRCUITS. Report No. 120. John Hill (Illinois. Univ., Urbana. Graduate Coll. and Illinois. Univ., Urbana. Digital Computer Lab.). June 22, 1962. Contract Nonr-1834(15). 36p.

Failsafe circuits are examined. In the circuits considered, the components are resistors, capacitors, inductors, connecting wires, and transistors. The investigation and mathematical analysis presented are limited to cases of single transistor failures. However, it is shown that failsafe circuits can withstand any single resistor, capacitor, or transistor failure, and that the failure indicator will signal any resistor or transistor which has ceased to operate. (J.R.D.)

29109 (NP-11954) RESEARCH ON THE VORTEX MHD POWER GENERATOR. First Quarterly Progress Report, July 1962. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Contract NAS3-2526. 25p.

Facilities were established which enable the operation of dual arc jets simultaneously for the testing of multiple jet vortex MHD generators. An experimental model of the vortex MHD generator was designed and is being fabricated. Visualization studies, utilizing tufts and ink injection, were conducted in an incompressible vortex. The limiting conditions (Reynolds number) for laminar vortex flow were observed. Other phenomena studied included the disturbances in the slip plane between the driving jet and the vortex flow field, and the flow in the region of a slotted center body cylinder. A vortex chamber was designed which will facilitate a study of the velocity field in a compressible vortex. Preliminary application of a pseudo-laminar type of boundary layer analysis was successfully employed for the description of turbulent flow profiles in a vortex which also contains a porous center body. (auth)

29110 (NYO-2667) LINE-SEGMENT DETECTOR FOR LINE PATTERNS. Technical Report No. 75. PEPR Report No. 1. Bernard F. Wadsworth (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Feb. 1962. Contract AT(30-1)-2098. 15p.

An experiment was conducted to determine the possibility of using a direct, analog approach to locate line segments in a pattern consisting of simple straight and curved line structures, and to determine what resolution is possible in a measurement of this type. A prototype device was constructed which can successfully locate line segments with better than ±2 degrees resolution. The device is considered more than adequate for pattern recognition of bubble-chamber events. (auth)

29111 (ORNL-1671) NEUTRON FLUX AND TISSUE DOSE STUDIES WITH FISSION THRESHOLD DETECTORS. PART I. EXPERIMENTAL MEASUREMENTS. G. S. Hurst, J. A. Harter, P. N. Hensley, and W. A. Mills (Oak Ridge National Lab., Tenn.). Mar. 30, 1954. Contract W-7405-eng-26. 24p.

Methods and apparatus used in neutron measurements during the Upshot/Knothole test series are described. The measurements were made to define tissue doses in terms of energy dissipated. Typical results obtained for one station and one shot are included. (J.R.D.)

29112 (ORNL-TM-330) A TRANSISTORIZED ALPHA COUNTER FOR AN ALPHA GAUGE. M. C. Kopp (Oak Ridge National Lab., Tenn.). Aug. 23, 1962. Contract [W-7405-Eng-26]. 12p.

A transistorized instrument prototype was designed and constructed to replace a vacuum-tube instrument in an alpha gauge, which measures the thickness density of gases. The instrument amplifies, shapes, discriminates, and counts alpha pulses from a Au-Si surface-barrier detector exposed to an alpha source in a gas-filled chamber. The circuit consists of a charge-sensitive preamplifier, a main amplifier with pulse clipping, a Schmitt trigger, a diode pump, and a count rate meter. Preliminary tests gave results comparable to the vacuum-tube instrument. Accuracy of counting was within 10% for 0.5- to 10-Mev alpha particles emitted at a maximum rate of 10^5 per sec. The instrument was stable at 25 to 55°C, is small and portable, and costs less than $500. An infinitely thick, alpha source that will give a high count rate is being constructed for final tests. (auth)

29113 (TID-12557) OPERATING EXPERIENCE WITH A SOLID STATE DATA LOGGER. O. J. Baker and H. F. Dunlap (Oak Ridge Gaseous Diffusion Plant, Tenn.). [Apr. 27, 1961]. Contract [W-7405-Eng-26]. 19p. (12-TC-61)

The design requirements and operating experience with a very accurate digital data logger are discussed. The basic requirements for this design were: high accuracy of the data obtained, maximum versatility in programming the sequence of data, and maximum reliability of the system. The speed of recording data is limited by the particular application. (auth)

29114 (TID-15474) A TRANSISTORIZED MULTI-CHANNEL GAMMA RAY AND NEUTRON MONITOR WITH LOGARITHMIC SCALE. Ivo Tammaru (California Inst. of Tech., Pasadena). Mar. 1, 1962. Contract Nonr-220(18). 33p.

Design and performance are described of a radiation detection instrument used to measure the fast neutron and gamma radiation levels around a 10-Mev tandem accelerator. The instrument has 12 channels, 2 for each of 6 monitoring stations, and γ radiation and neutron flux are recorded separately. It is wholly transistorized and features a single logarithmic ratemeter scale and warning system for each channel. Schematic sketches of the circuits are included. (C.H.)

29115 (TID-16345) A FAST COINCIDENCE SINGLE-CHANNEL SPECTROMETER (thesis). John R. Mann (Vanderbilt Univ., Nashville. Graduate School). June 1962. 71p.

A fast coincidence spectrometer was designed to be used for recording $\beta-\gamma$ coincidences at faster resolving times than were available with previous electronics. The instru-

ment has a minimum resolving time of 0.01 μsec with pulse height selection available for both channels. A plastic phosphor detector is used in the beta channel and a NaI(Tl) detector analyzes the photons from the beta source. The detectors, amplifiers, single-channel analyzers, coincidence circuit, timers, and scalers are described. Theory and method of operation and alignment are discussed. Single-channel analyzer resolution, quantitative measurements, and sources of error are also discussed. (M.C.G.)

29116 (UCRL-9052) SILICON P-N JUNCTIONS AS CHARGED-PARTICLE DETECTORS. Glen E. Gordon, George W. Kilian, Almon E. Larsh, and Torbjoern Sikkeland (California. Univ., Berkeley. Lawrence Radiation Lab.). Jan. 1960. Contract W-7405-eng-48. 5p.

Investigations of the electrical response of diffused p-n junctions were made on detectors obtained from two sources. A curve of output-pulse amplitude vs energy for a range of alpha particles from 3.2 to 7.68 Mev was drawn. When the data were corrected for energy loss in the insensitive region, the curve went through the origin. Energies of C^{12} ions and fragments from fission of Cf^{252} were also plotted vs output-pulse. It was concluded that there is very little or no ionization defect for fission fragments in the solid-state detector. (M.C.G.)

29117 (AEC-tr-5097) THE APPLICATION OF β-RAY EXCITATION FLUORESCENCE TO THE MEASUREMENT OF THE THICKNESS OF DEPOSITS AND TO ANALYSIS. P. Martinelli and G. Seibel. Translated from p.307-13 of "Colloquium Spectroscopicum Internationale VIII, 1959." 20p.

Also issued in the original as reprint CEA-1945.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 22475.

29118 (AEC-tr-5275) ELECTRON OPTICAL SYSTEM FOR THE PRODUCTION OF A SMALL ELECTRON PROBE. T. Mulvey. Translated by Sharon Bogue (Ames Lab., Ames, Iowa) from the "4th International Conference on Electron. Microscopy, Berlin, September 10-17, 1958." 9p.

The design of electron optical systems for the production of small electron probes is discussed in terms of electron lenses with greater working lengths, asymmetrical lenses, practical construction, and electron screen systems. (B.O.G.)

29119 (AEC-tr-5282) INFLUENCE OF STRAY MAGNETIC FIELDS ON THE POSITION AND QUALITY OF IMAGES IN MASS SPECTROGRAPHS AND SPECTROMETERS. Richard F. K. Herzog. Translated from Z. Naturforsch., 10a: 887-93(1955). 19p.

Results of an investigation concerning the errors which may result from neglect of the stray magnetic fields in spectrographs and spectrometers are presented. Methods of incorporating stray fields in the application of elementary theory are also discussed. (J.R.D.)

29120 (AEC-tr-5314) THE IMPROVEMENT AND PRESENT CAPABILITY OF THE DOUBLE FOCUSING MASS-SPECTROGRAPH. R. Bieri, F. Everling, and J. Mattauch. Translated from Z. Naturforsch., 10a: 659-67(1955). 17p.

A series of improvements are described that were made on a mass spectrograph in recent years. In addition to attaining a more rapid and reliable operation of the equipment, the improvements cover a more exact adaptation to theoretical requirements, the enlargement and increase in stability of the beam justification process, the vacuum system, and the attainment of constant field strength. The resolution which gave a value of M/dM = 100,000 at good exposures is proof of the capability of the instrument. (auth)

29121 (FTD-TT-62-368) AN ULTRASONIC FLAW DETECTOR FOR TESTING WELDED METAL SAMPLES. V. M. Zabolotskii (Zaboltskiy), B. A. Kalugin, G. Serebryakov, et al. Translated from U.S.S.R. Patent No. 139470. May 3, 1960. 4p.

Design of a proposed ultrasonic flaw detector for determining hot crack formation in metallic welds is described. (J.R.D.)

29122 (SCL-T-430) ELECTRON PROBE MICROANALYZER. Yoneichiro Sakaki and Takashi Nagatani. Translated by Noburu Hiraga (Sandia Corp., Albuquerque, N. Mex.) from J. Electronmicroscopy, 10: No. 2, 65-76 (1961). 28p.

A description of the design and use of the electron probe microanalyzer (EPMA) is presented. Characteristic x rays from elements bombarded by electrons are the basis of the analysis performed by such instruments. Included are discussions of EPMA construction, adjustments and interpretation of results, examples of applications, and present state of development. (J.R.D.)

29123 SOME CHARACTERISTICS OF A β-RAY ARGON TETRODE DETECTOR. Oern Wahlroos (Biochemical Inst., Helsinki). Acta Chem. Scand., 16: 1039-40(1962). (In English)

A fourth electrode can be inserted into the argon triode gas chromatographic detector to decrease the noise level and increase its sensitivity. Some of the properties of the resulting tetrode were determined with butane as the test substance and Sr^{90} as the electron source. Graphs of sensitivity vs screen grid voltage and of anode and collector grid currents vs anode voltage are given. The ionization efficiency of the tetrode at maximum sensitivity is ~20 coulomb/g, and the linear range is ~10^3. Another electrode configuration is described in which the screen electrode may be used to collect negative ions formed by electron capture. (D.L.C.)

29124 DIRECT-READING BERYLLIUM SPECTROGRAPH. Walter A. Van Sandt, Vincent C. Santomassino, Robert P. Rumble, and Oran M. Barlow (Univ. of California, Livermore). Am. Ind. Hyg. Assoc. J., 23: 203-13(May–June 1962). (UCRL-6363)

A direct-reading emission spectrograph for the quantitative determination of beryllium on one-inch diameter filter paper discs has been developed to relieve the workload on the industrial hygiene chemistry laboratory. The instrument uses a Bausch and Lomb grating monochromator as its basic unit. Operation of the spectrograph is automatic; the amount of beryllium on the filter paper is read directly from a meter. The filter paper sample discs are used with specially designed high-purity graphite electrodes. Spark excitation of the sample is by a small Bausch and Lomb spark source. The instrument is suitable for detecting concentrations of beryllium ranging from 0.01 to 10 micrograms. (auth)

29125 THE DIRECTIONAL DEPENDENCE OF AIR SAMPLERS. Harold Glauberman (Health and Safety Lab., AEC, New York). Am. Ind. Hyg. Assoc. J., 23: 235-9 (May–June 1962).

Two filtration-type air samplers were tested in turbulent or positive directional air streams to determine if sampling is dependent on orientation of the sampling instrument. Uranium oxide dusts of 0.76, 2, and 3.25 microns median diameters were collected on Whatman #41 filter discs. In turbulent air no bias was found due to orientation. In a directional air stream, a sampler head facing into the air stream collected more dust by a factor of two. (auth)

29126 IMPROVED EXPERIMENTAL METHODS FOR ELECTRON–GAMMA DIRECTIONAL CORRELATION MEASUREMENTS. T. R. Gerholm, R. Othaz, and M. S. El-Nesr (Univ. of Uppsala). Arkiv Fysik, 21: 253-88 (1962).

A new instrument for electron–gamma directional correlation measurements is described. Magnetic momentum selection is provided in the electron channel which consists of an iron encapsuled long lens beta ray spectrometer with "triangular field" focusing. The instrument is a modification of the electron–electron coincidence spectrometer earlier developed by Gerholm. In view of the close connection between electron–electron coincidence and short lifetime measurements and the electron–gamma coincidence and directional correlation experiments it was considered desirable to make the new construction such that the instrument easily can be converted from the electron–electron mode of operation into the electron–gamma set up. This readjustment can be made in less than half an hour, and involves only a replacement of one of the two magnetic lenses by an angular correlation table together with minor modifications of electron baffles and source holder. The source and the center of rotation of the gamma-channel can be adjusted in situ to within less than 0.05 mm. A new method has been developed which allows a direct, accurate, and speedy experimental determination of the appropriate correction factor for the finite aperture angle of the electron channel. There is no magnetic interference between the electron and gamma channels. The scattering problem has been carefully investigated and found to be insignificant under normal circumstances. The figures of merit of the new instrument were found to be superior to those of existing similar instruments. It is shown that the experimental facilities provided can be extended in a straightforward way without any further modifications of the present spectrometer. A three channel arrangement is proposed, which in combination with a multichannel analyzer and automatic operation would increase the present measuring efficiency by more than two orders of magnitude and simultaneously give a considerable increase in the accuracy of the experimental results. Some checking experiments have been performed. These concern both beta–gamma and conversion electron–gamma directional correlations as well as transmission calibrations at two different energies. (auth)

29127 THE CANBERRA HOMOPOLAR GENERATOR. L. U. Hibbard (Australian National Univ., Canberra). Atomic Energy 5, No. 3: 2-5(July 1962).

The main features of the generator are outlined. The generator is designed to deliver 1.5-Ma current pulses at 800 v, with a duration of 2 sec. (T.F.H.)

29128 THE LIQUID METAL JET SYSTEM. E. K. Inall (Australian National Univ., Canberra). Atomic Energy 5, No. 3: 6-8(July 1962).

The handling and decontamination of the NaK alloy used as liquid-metal slip-rings (brushes in the Canberra homopolar pulse generator is described. The alloy is sprayed through jets onto the faces of the generator rotors. The conditions of use of the alloy (about room temperature, velocities in the jets around 20 m/sec, peak current densities over 40 ka/cm^2, etc.) are outlined. (T.F.H.)

29129 EFFECT OF THE CHEMICAL SENSITIZATION OF SILVER BROMIDE EMULSIONS ON THEIR DEVELOPABILITY WITH RESPECT TO LIGHT AND IONIZING AGENTS. G. Danguy (Université Liège). Bull. soc. roy. sci. Liege, 31: 580-604(1962). (In French)

The chemical sensitivity of AgBr homogeneous emulsions to light, x rays, α particles, and β particles was studied. (tr-auth)

29130 AUTOMATIC REGULATOR OF X-RAY BEAM INTENSITY. K. Kuderna and K. Toman. Československ. časopis pro fysik, 12: 346-52(1962). (In Czech)

Equipment is described that automatically maintains the intensity of x-rays at a constant, previously set value. The influence of the non-monochromatization of the radiation and of the internal changes in the x-ray tube on the stability of the intensity of the primary beam, for two different locations of the control element, is tested experimentally. (auth)

29131 FISSION DETECTOR OF THERMAL NEUTRONS. Vl. Kadlec and Fr. Krýl. Československ. časopis pro fysiku, 12: 363-8(1962). (In Czech)

A fission chamber with U^{235} with spiral electrodes is described, along with the preparation of a fissionable layer. The coated area is 160 cm^2 and the distance between the electrodes is 3.5 mm. The basic characteristics of the chamber are measured as a function of the pressure of the argon filling and the thickness of the fissionable layer. The influence of gamma rays on the efficiency of the chamber is found in a gamma field having an intensity of the order of 10^5 r/hr. (auth)

29132 ON THE ANALYSIS OF GAMMA RAY PULSE HEIGHT SPECTRA. Jacob Israel Trombka (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 193(July 1962).

A method for determining the gamma ray energy spectrum from the pulse height spectrum measured using a NaI(Tl) scintillation detector was developed. The polyenergetic gamma pulse height spectrum was synthesized by using a series of normalized pulse height distributions characteristic of the various monoenergetic components in the beam. The contribution of each of the monoenergetic components to the pulse height spectrum was determined using least square fitting techniques. The calculations are programmed for use on an IBM 704 computer. From a knowledge of the contribution of each monoenergetic component and crystal efficiency for each given energy, the energy spectrum incident upon the crystal can be determined. The method was extended to the analysis of continuous gamma ray energy spectra. A general technique for pulse height analysis, the so-called dynamic least squares peeling off process, is also proposed. The shape of the pulse height spectra and also the crystal efficiencies are dependent upon source-detector geometry for cylindrical NaI(Tl) crystals. Experimental and theoretical results indicate that this geometrical dependence can be greatly reduced if spherical crystals are used. Thus in certain cases where source-detector geometry cannot be specified, gamma energy spectra can still be determined from the measurement of pulse height spectra. The techniques were applied to a number of problems, the determination of thermal fluxes, the determination of complex decay schemes, and the determination of linear absorption coefficients and energy build-up factor of 0.66 Mev passing through steel shields. Experimental results were obtained, and compared with theoretical calculations. (auth)

29133 SIMULATION OF A MECHANICAL NEUTRON SELECTOR. G. Bortone and B. Faleschini (SMI, Milan and CNEN, Ispra, Italy). Energia nucleare (Milan), 9: 326-32(June 1962). (In Italian)

A technique is described to simulate the operation of a neutron chopper. This technique was used to set up a general purpose code for the USS 90, with which it is possible to study choppers of any shape; in particular, parametrical studies on optimization of outlines can be made by means of

this code. The numerical calculation that was made up confirms that in this kind of problem simulation compares very favorably with the analytical methods generally followed. (auth)

29134 RADIATION DETECTORS USING SEMICONDUCTOR JUNCTIONS. Eiji Sakai. Genshiryoku Kōgyō, 7: No. 3, 41-6(Mar. 1961).

A semiconductor-junction-type radiation detector, based on the principle that when radiation penetrates into the semiconductor positive holes and electrons are produced, is described, and the advantages and disadvantages are discussed. The methods of construction of the surface-barrier type and p-n diffusion-type semiconductor detectors are described. The applications of semiconductors as pencil-type survey meters and neutron counters are discussed. (OID)

29135 CHARACTERISTICS OF THE RADIATION POLYMERIZATION DOSIMETER. F. E. Hoecker (Univ. of Kansas, Lawrence). Health Phys., 8: 381-9(Aug. 1962).

The range of the radiation polymerization dosimeter, originally developed to indicate the absorption of large doses of radiation without the use of any auxiliary equipment, was extended from 300 to 10^7 rads. Extensive investigations disclosed the absence of dose-rate dependence at dose-rates above 2500 rads/min, and the absence of energy dependence for x and γ rays with half-value thickness above 1.0 mm of copper, and for high-energy electron beams. Temperature dependence during irradiation between −5 and 38°C was found to be 5%. Cells designed for large doses can be stored for several months at room temperature without significant change in dose. High-sensitivity cells stored at room temperature suffer a dose change of approximately 1% per day but can be stored for several months at 0°F or below without significant change in dose. The dosimetric cells are small ($\frac{1}{2}$ ml volume), expendable, have a sharp, irreversible end-point, and may be read instantly by untrained personnel. (auth)

29136 COMPONENTS AND APPLICATION TECHNIQUES FOR ELECTRONIC CIRCUITRY OPERATING IN NUCLEAR ENVIRONMENTS. L. T. Bowles, J. R. Crittenden, and E. L. Davis (General Electric Co., Owensboro, Ky.). IRE Trans. on Nuclear Sci. NS-9, No. 4, 5-8(Aug. 1962).

A discussion is presented of the effects of steady-state, pulsed, and natural space radiation on electronic equipment. The effects of steady-state irradiations of various active and passive circuit element materials with up to 10^{20} nvt of fast neutrons and 10^{12} r of gamma rays are outlined. The effects of gamma pulses of about 10^9 to 10^7 r/sec on the responses and properties of circuit elements are discussed. The effects of dose rate on conductivity of various insulators is shown at several temperatures. The nature of space radiations is considered. (T.F.H.)

29137 A FAST, HIGH-CURRENT PHOTOMULTIPLIER. L. F. Wouters, A. E. Villaire, V. E. Wheeler, and R. Kalibjian (Univ. of California, Livermore). IRE Trans. on Nuclear Sci. NS-9, No. 4, 9-14(Aug. 1962).

The development of the dynode section of a sub-nsec photomultiplier with an output of >2 amp is described. The estimated transit time per stage is about 0.3 nsec, with a spread of about 0.01 nsec. Results using 12 dynodes are outlined. The tube has a very short acceleration-deceleration region, which gives a short transit time and a small transit-time dispersion. (T.F.H.)

29138 NUCLEAR PULSE CURRENT-SENSITIVE AMPLIFIERS. Irving M. Meth and Robert T. Graveson (Health and Safety Lab., AEC, New York). IRE Trans. on Nuclear Sci. NS-9, No. 4, 15-19(Aug. 1962).

The development of current-sensitive feedback amplifiers and their application to nuclear instrumentation is described, and is exemplified by a non-overloading amplifier stage. Characteristics of this stage include a stage gain of 40, a loop gain of 250, a rise time of 0.2 μsec, and an input resistance of six ohms. Specific applications include uses in linear current discriminators, current-to-voltage converters, charge integrators, and delay line shapers. A review of feedback theory and design equations is included. (auth)

29139 A LOW NOISE HIGH GAIN BANDWIDTH CHARGE SENSITIVE PREAMPLIFIER. Jack Hahn and Ralph Mayer (Columbia Univ., New York). IRE Trans. on Nuclear Sci. NS-9, No. 4, 20-8(Aug. 1962).

The concept of the charge-sensitive amplifier is discussed, and a method for obtaining a high-gain amplifier stage through the use of a positive-current-feedback dynamic plate load is described. It is shown that under certain conditions this type of feedback can provide increased bandwidth as well as increased low-frequency gain. The schematic of a preamplifier embodying these principles is given and its performance is described. The measured noise, with no external capacitance, is 510 rms electrons for equal integration and differentiation time constants of 1 μsec. The measured risetimes for closed-loop gains of 100 and 1000 are 25 and 96 nanoseconds respectively. Linearity and gain sensitivity data are also included. (auth)

29140 APPLICATION OF AVALANCHE TRANSISTORS TO 10-MEGACYCLE PULSE GENERATORS. Michael Bramson (Baird-Atomic, Inc., Cambridge, Mass.). IRE Trans. on Nuclear Sci. NS-9, No. 4, 35-7(Aug. 1962).

When using avalanche transistors at high continuous repetition rates and particularly at large duty cycles, problems are encountered. Some desirable avalanche transistor parameters and some suitable basic circuit configurations are indicated. A triggerable pulse generator that operates at over 10 megacycles and produces pulse widths adjustable from a few nanoseconds to 40-percent duty cycle is described. These pulses are of low time-jitter and are approximately rectangular with about 2-nanosecond rise and fall times at 50 ma on 125 ohms. (auth)

29141 LITHIUM-DRIFTER p-i-n JUNCTION DETECTORS. H. M. Mann, J. W. Haslett, and F. J. Janarek (Argonne National Lab., Ill.). IRE Trans. on Nuclear Sci. NS-9, No. 4, 43-54(Aug. 1962).

Lithium-ion-drifted diodes were prepared by diffusion of lithium into silicon in vacuo at 350 to 400°C, followed by electric-field-drift in a silicone oil bath at 150°C. Extension of the sensitive region toward the p-type surface was interrupted and observed intermittently by means of alpha particles incident upon this surface at energies from 6 to 9 Mev. Ion-drift was then continued until the plot of pulse-height vs energy for these alpha particles showed a negligible (<50 kev) energy intercept for distances of drift up to 4 mm from the lithium-diffused surface. The response to protons at energies from 4.5 to 10 Mev was linear to within ± 0.3%. The resolution width (FWHM) for protons at the higher energy, for deuterons at 20 Mev, and for alpha particles at 40 Mev was limited by beam energy spread in a cyclotron. At room temperature, resolution widths down to 20 kev were observed for electrons at energies of 0.5 and 1 Mev, and that for gamma rays was 9 kev at 661 kev. Resolution widths down to 12 or 13 kev were observed

for electrons at 1 Mev when the detectors were cooled to liquid nitrogen temperature. (auth)

29142 COMPARISON OF THE MERITS OF PROXIMITY AND MAGNETIC FOCUSING IN IMAGE TUBES. G. Papp (ITT Industrial Labs., Fort Wayne). IRE Trans. on Nuclear Sci. NS-9, No. 4, 55-60(Aug. 1962).

An image tube with proximity focusing, i.e., with closely spaced photocathode and phosphor, is compared with an image tube with the simplest magnetic focusing produced by homogeneous, parallel electric and magnetic fields. Both types of focusing give a 1:1 magnification and can be applied to large image areas. As long as the homogeneity of the fields is maintained, the resolution is uniform over the total picture area in both cases. The accuracy of focusing in the two cases is derived. While the error is a first order expression of the ratio of the initial and end velocities in the proximity focusing, the first order term disappears in the magnetic focusing and a second order expression remains for the error. This result shows the superiority of the magnetic focusing. By taking account of the statistical distribution of initial velocities, the resolution obtainable with proximity focusing is calculated. Particular attention is drawn to the fact that, in an actual experiment, the errors of different origin are not always independent of each other and therefore do not add quadratically. This effect is demonstrated for the magnetic case. (auth)

29143 MEASUREMENT OF DELAY TIME IN COAXIAL CABLES BY PULSE TECHNIQUE. J. L. Menke and R. R. Fullwood (Rensselaer Polytechnic Inst., Troy, N. Y.). IRE Trans. on Nuclear Sci. NS-9, No. 4, 61-2 (Aug. 1962).

A pulse generator having a high repetition rate and rise time is used to measure the delay per ft in coaxial cables. The pulses are introduced into one end of the cable through a resistor mixing pad, and the cable is efficiently shorted. The pulse repetition rate is varied until the production of a given pulse coincides with the return of the reflection of the previous pulse. The null of the two signals is not completely unambiguous because of degradation of the returning pulse. The accuracy of the method, however, is about 0.3%. (T.F.H.)

29144 THE EFFECT OF PULSE SHAPING ON THE S/N RATIO OF PULSE AMPLIFIERS FOR USE WITH SOLID STATE RADIATION DETECTORS. Masahiro Tsukuda (St. Paul's Univ., Tokyo). IRE Trans. on Nuclear Sci. NS-9, No. 4, 63-5(Aug. 1962).

It is shown that the noise performance of the double delay line clipper is not noticeably inferior to that of the single RC clipper, in pulse amplifiers for use with solid-state radiation detectors. The noise characteristics of a single delay line and double RC clippers are also investigated. (T.F.H.)

29145 COUNTING AND CONTROL UNIT FOR A SAMPLE CHANGER WITH A 4 π COUNTER. T. Friese (Hahn-Meitner-Institut fur Kernforschung, Sektor Kernchemie, Abteilung Elektronik, Berlin). Kerntechnik, 4: 274-6(July 1962). (In German)

A transistorized counting and control unit was developed for use with a sample changer in connection with a 4 π counter. The pulses generated in the two halves of the 4 π counter are registered in a counting-printer after having passed a coincidence-anticoincidence circuit. Automatic deadtime correction is obtained by lifetime measurement. Pulses coming from the two single halves as well as from both halves of the 4 π counter will be counted and printed by the unit automatically. (auth)

29146 A GERMANIUM BENT-CRYSTAL MONOCHROMATOR FOR NUCLEAR SPECTROSCOPY. E. J. Seppi, H. Henrikson, F. Boehm, and J. W. M. Dumond (California Inst. of Tech., Pasadena). Nuclear Instr. & Methods, 16: 17-28(June 1962). (In English)

A precision bent-crystal gamma monochromator with a stationary source was built. The instrument consists of three physically indpendent units: the line source (a radioactive source or the anode of an x-ray tube); the 2 meter-radius bent diffraction-crystal with its pivot and sine-motion mechanism; and the heavy-duty curved track framework that supports the collimator, detector, and shielding. The motions of the crystal-pivot unit and of the detector-carriage unit are linked together in such a way that the reflection condition is satisfied. Results are presented showing that the precision of the monochromator for measurement of γ wavelengths is 0.003 x-units. The line width at half maximum, $\Delta\lambda$, observed when the (800) planes of a bent germanium crystal are used is 0.08 x-units. The resolution attained with the germanium crystal is illustrated by a measurement of the 244.264, 246.056, and 245.237 kev gamma lines in the decay of W^{183}. Finally, experimental results obtained using the monochromator to observe nuclear resonance excitation in F^{19} and Mn^{55} are described. (auth)

29147 ABSOLUTE MEASUREMENT OF PARTICLE FLUX DENSITY OF FAST ELECTRONS WITH A FARADAY CUP. J. Kretschko, D. Harder, and W. Pohlit (Max Planck-Institut für Biophysik, Frankfurt am Main). Nuclear Instr. & Methods, 16: 29-36(June 1962). (In German)

A method for the absolute measurement of the particle flux density of fast electrons with a Faraday cup device is described. The Faraday cup consists of a graphite cylinder for the total absorption of electrons up to 35 Mev. The charge of electrons collected in a given time interval by the graphite absorber is measured absolutely by a charge-compensation method (accuracy better than 0.5%), and from this the particle flux density is determined. The corrections for deficient absorption, ionization in the remaining gas, backscattering of electrons, production of bremsstrahlung, emission of secondary electrons from the window of the Faraday cup, and the influence of the radiation background are accurately determined for electron energies from 10 to 25 Mev. Hence the total error of the measurement of the particle flux density with this device is about 1%. (auth)

29148 A SMALL, LINEAR, WIDE RANGE NUCLEAR RADIATION DETECTOR. T. A. Rabson (Rice Univ., Houston, Tex.). Nuclear Instr. & Methods, 16: 37-8(June 1962). (In English)

A simple nuclear radiation detector is produced using a scintillation element and a CdS photoresistive cell, which possesses the properties of linearity over a wide energy range, small size, and energy independence. Several scintillation materials including NaI and Pilot B are tested. (auth)

29149 SIMPLE LOGARITHMIC PULSE HEIGHT ANALYSERS. J. C. Barton and A. Crispin (Northern Polytechnic, London). Nuclear Instr. & Methods, 16: 39-43(June 1962). (In English)

A type of multichannel analyzer is described in which the pulse height is encoded by applying it to a ringing circuit and counting the number of cycles before the oscillation decays to a fixed level. With a 10% channel width the dynamic range of the 64-channel instrument described is 400:1. Possible types of readout are discussed, and various solutions are suggested that are compatible with the

simplicity, reliability, and stability of the remainder of the analyzer. (auth)

29150 DEPENDENCE OF TIME AND AMPLITUDE PROPERTIES OF A NEW MILLIMICROSECOND-PHOTOMULTIPLIER UPON THE OPERATING PARAMETERS. A. Eckardt (Friedrich Schiller Univ., Jena, Ger.), P. Goerlich, H. J. Pohl, and R. Prager. Nuclear Instr. & Methods, 16: 44-50(June 1962). (In English)

Using a millimicrosecond photomultiplier with a meander-shaped dynode arrangement it is shown how the pulse behavior (form and height) can be affected by different electrical potentials. Results are presented of comparisons of the three types 6810A, 56 AVPa, and K 12 FS 50, adjusted for optimum operation relative to the time behavior. Finally, reference is made to oscillation phenomena, which may manifest themselves under conditions of extreme adjustments of the potentials at the last dynode stages. (auth)

29151 INTENSITY DETERMINATION OF PHOTOGRAPHICALLY RECORDED CONVERSION LINES. Hilding Slaetis (Nobel Inst. of Physics, Stockholm). Nuclear Instr. & Methods, 16: 51-8(June 1962). (In English)

The determination of the relative intensity of conversion lines recorded photographically in a semicircular beta spectrometer is treated. Two methods are briefly described, both of which are based on the Silberstein formula for the photographic density as a function of the electron density. In the first method the influence of the photographic sensitivity versus electron momentum is considered. In the second method, the calibration is specific for the spectrometer and film type used. By this means sources of error, for instance the influence of the varying differential grain density along the electron tracks, are eliminated. Both methods can be used with or without the so-called "rectangle" approximation, consisting in replacing the integrated area under a conversion line by a rectangle, the height of which is equal to the height of the electron intensity distribution line and the width of which is equal to the true half-width of the line. (auth)

29152 A NEW TYPE OF FAST AMPLIFIER. M. Ageno and C. Felici (Istituto Superiore di Sanità, Rome). Nuclear Instr. & Methods, 16: 59-62(June 1962). (In English)

A fast amplifier is built that is simpler, rougher, and more stable than the distributed amplifier, with which it can compete in gain and rise time. The principle on which the circuit operates is described and the rise-time and frequency response are calculated. Typical transistorized schemes are presented with gains of 8 and 400 and rise times of 4.2 and 12 nsec respectively. (auth)

29153 THE DETERMINATION OF MASS DISCRIMINATION IN A MASS SPECTROMETER. G. H. Debus (EURATOM, Central Bureau for Nuclear Measurements, Geel, Belgium). Nuclear Instr. & Methods, 16: 63-8(June 1962). (In English)

A general formula is derived to calculate mass discrimination in a mass spectrometer, from experimental values obtained with blends of enriched and depleted isotopic material. The optimum condition for detection of mass discrimination is given. A table is added indicating the limitations of this method both as a function of the statistical errors of blending and of mass spectrometric measurements, and as a function of the isotopic purity of the source material for blending. (auth)

29154 LOADING DEVICE FOR IRRADIATED SAMPLES AT A BENT CRYSTAL GAMMA-RAY SPECTROMETER. S. Nilsson (Chalmers Univ. of Tech., Göteborg). Nuclear Instr. & Methods, 16: 89-96(June 1962). (In English)

In order to make possible precision measurements of comparably short-lived, neutron-induced activities, a receiving station is constructed for use with a bent quartz crystal spectrometer. The problem of choosing a material for the source container is discussed. For this purpose almost spectroscopically pure titanium proves to be suitable. (auth)

29155 EFFECT OF SAMPLE NONUNIFORMITY ON CROSS SECTION MEASUREMENTS. O. D. Simpson, N. H. Marshall, and R. C. Young (Phillips Petroleum Co., Idaho Falls, Idaho). Nuclear Instr. & Methods, 16: 97-100(June 1962). (In English)

A technique is discussed for making corrections to cross sections obtained from transmission measurements on nonuniform samples. Experimental tests are made on samples with known nonuniformities to check the validity of the correction equation. The technique is applicable to any transmission measurement where the sample nonuniformity can be determined. Techniques are also described by which estimates can be made of the effects of undetected sample nonuniformities. (auth)

29156 REGISTRATION OF RAPID VARIATIONS OF COUNTING RATES. Alipio L. Dias Neto (Universidade, São Paulo, Brazil). Nuclear-Med., 2: 429-34(1962). (In English)

A system for recording rapid variations of counting rates is described which produces graphs free of the deformations usually introduced by the use of a ratemeter-recorder system. This system consists of a binary scaler, a modified isotope scanner and a commercial magnetic tape recorder. The counting rates are initially recorded on tape which is then played back at half speed and the count-rates fed into the scaler and scanner. The printer of the scaler, the head of which remains fixed, is used to produce marks on the recording paper moving at a constant speed. Pulses accumulated per $\frac{1}{10}$ sec are then plotted against time to produce a curve illustrating the variations of counting rate with time. This method of recording is useful in all those types of studies where rapid variations of counting rates have to be recorded. (auth)

29157 NOISE AND DISCRIMINATOR BIAS. Edward Fairstein (Tennelec Instrument Co., Inc., Oak Ridge, Tenn.). Nucleonics, 20: No. 8, 148-9(Aug. 1962).

A graph is given for helping in the choice of the optimum discriminator threshold of the counting channel for total-activity measurements of emitters with energies below 100 kev. The noise is assumed to be due to grid-current noise or shot noise in the input tube of the pulse amplifier. The graph is noise count vs ratio of discriminator bias to rms noise level, and an example is given of the use of the graph to calculate the discriminator energy for a given preamplifier-detector combination. (D.L.C.)

29158 EXTERNAL DETECTION OF GAMMA-RAY FIELD ARISING FROM A GAMMA OR POSITRON SOURCE SITUATED IN AIR OR IN AN ABSORPTION MEDIUM. Ladislav A. Jenček. Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 3-18(Dec. 1961). (In Yugoslavian)

The visualization of distribution of radioactive isotopes in vivo is an increasingly important application of radioactive material in medicine. Experimental and theoretical studies were made of the resolution of a scintillation counter with cylindrical and focusing collimators to a point radioactive source which may move throughout the region seen by the collimator. The effect of scattering in a semi-infinite absorption medium and the effect of penetration through the collimator wall was determined. In the second part of this paper the detection of annihilation radiation re-

sulting from positron detection of As-72 for a point and extended source is considered. The resolution and efficiency of the single channel and coincidence systems are compared. (auth)

29159 APPARATUS FOR MEASUREMENT OF RADIOACTIVITY OF EXCRETA AND OF THE SMALL ANIMALS. Petar Gugić ([Univ. of Zagreb]). Primena Radioaktiv. Izotopa i Jonizujucih Zracenja u Med., 2: No. 3, 19-22 (Dec. 1961). (In Yugoslavian)

Construction and characteristics of an economical simple apparatus for the measurement of comparatively large amounts of radioactive liquids is presented. The apparatus is made of lead chamber, a battery of GM counters, and an electric quenching unit with a cathode follower. The apparatus has proved very suitable for the measurement of excreta radioactivity. It can also be used in the application of iodine to small laboratory animals. (auth)

29160 ELECTROSTATIC QUADRUPOLE LENS PAIR FOR MASS SPECTROMETERS. Chih-Shun Lu and Howard E. Carr (Auburn Univ., Ala.). Rev. Sci. Instr., 33: 823-4(Aug. 1962).

The focusing properties of a quadrupole lens pair were studied under conditions to produce a wedge-shaped ion beam for a mass spectrometer. The lens equations were analyzed numerically and resulting graphs are given for the determination of various lens parameters. (auth)

29161 BUBBLE CHAMBER CONTROL AND ALARM CIRCUITS USING SOLID STATE ELEMENTS. H. Fechter (Univ. of Colorado, Boulder) and Z. Sztankay. Rev. Sci. Instr., 33: 825-8(Aug. 1962).

Power transistors delivering 8-amp pulses of 2-msec width are used to drive low impedance coils in Ross and Barksdale valves. Unijunction transistors and Thyristors are used to replace all relays and lamp flasher elements in compact, reliable alarm units of new design. Life tests equivalent to many years operation at accelerator sites have been carried out. There has not yet been any failure in operation. (auth)

29162 TRIGGERED FILM ADVANCE SYSTEM. Kenneth Lande, Alfred K. Mann, and D. Hywel White (Univ. of Pennsylvania, Philadelphia). Rev. Sci. Instr., 33: 823-31 (Aug. 1962).

A system is described which provides a triggering signal for a scintillation or spark chamber from a coincidence circuit. Power is supplied to label the recording film with a register number and to advance the film to a clear position. Multiple exposures of events are prevented. (auth)

29163 PULSED VOLTAGE MULTIPLIER. R. C. Mobley (Louisiana State Univ., Baton Rouge). Rev. Sci. Instr., 33: 839-40(Aug. 1962).

A suggested multistage high-voltage multiplier design utilizing a low duty cycle 10-kc pulse drive was built, tested, and found reliably operable at twice the dc voltage gain per rectifier stage of conventional sine wave drive Cockcroft-Walton multipliers. Low-capacitance rf tuned circuits across the ends of similarly tuned filament and anode lines permit simultaneous independent utilization of these lines for conveying pulse drive and rf filament heating current. A novel rf compensating and pulse canceling arrangement substantially eliminates output voltage ripple. The ten-stage prototype tested utilizes miniature commercial 1AX2 vacuum rectifiers and 20-kv T.V. doorknob condensers and was successfully operated at output voltages in excess of 250 kv and at output currents exceeding 500 μa. Output impedance was 60 MΩ. Voltage gains in excess of 200 kv/ft appear feasible. (auth)

29164 SLOTTED-DISK VELOCITY SELECTOR OF EXTENDED RANGE. S. M. Trujillo, P. K. Rol, and Erhard W. Rothe (General Dynamics/Astronautics, San Diego, Calif.). Rev. Sci. Instr., 33: 841-3(Aug. 1962).

A slotted-disk, mechanical velocity selector was constructed and tested. It is similar to that reported by Hostettler and Bernstein, but may be used at velocities more than five times higher (to 6000 m/sec). Its velocity spread is somewhat less (3.4%), and its fractional open time is about the same (34.8%) as the Hostettler-Bernstein instrument. A lithium beam was velocity analyzed and found to be in agreement with the calculated distribution. (auth)

29165 PHOTOGRAPHIC DETECTORS FOR NEUTRON DIFFRACTION. Harold Berger (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 844-6(Aug. 1962). (ANL-FGF-328)

Although new boron- and lithium-loaded scintillators yield very fast photographic response for thermal neutrons, it is pointed out that reciprocity-law failure responses will complicate intensity analyses of diffraction pattern films made with these techniques. The magnitude of this effect for a B^{10}-loaded scintillator and type F x-ray film is such that the response is decreased by a factor of at least 4 times at a neutron intensity of 3×10^3 neutrons/cm^2-sec when compared to the response at a neutron intensity 100 times higher. This objection, and that of image nonuniformities, can be eliminated by using slower response metal screens and film detectors. A rhodium-gadolinium screen combination used with a fast x/ray film such as type KK is shown to be a fast technique which will yield diffraction patterns having useful intensity information. (auth)

29166 APPARATUS FOR CONTINUOUS RECORDING OF INTERNAL FRICTION. P. Kofstad, R. A. Butera, and R. S. Craig (Univ. of Pittsburgh). Rev. Sci. Instr., 33: 850-3(Aug. 1962).

An internal friction apparatus based upon the principle of the torsion pendulum is described. Attached to the inertia member of the pendulum are two coaxial coils which are located in the field of a permanent magnet. Oscillations of the pendulum induce an emf in one coil (the pick-up coil). The signal is amplified and converted into a square wave of constant amplitude which is used to energize the other coil (the driver coil). Interaction between the driver coil and the magnetic field maintains the system in oscillation, the amplitude being proportional to Q. The output of the pickup coil is measured on a strip chart recorder. After a straightforward calibration procedure the Q of the system is quantitatively related to the output. The device has been used from 4°K to 150°C. (auth)

29167 SPARK CHAMBER TRACK MEASURING SYSTEM. James A. DeShong, Jr. (Argonne National Lab., Ill.). Rev. Sci. Instr., 33: 859-65(Aug. 1962).

A system is described for the projection, digitizing, and recording of photographed spark chamber tracks. A Sio-Syn-driven projector automatically frames the film and projects the tracks on a screen mounted in a precision commercial plotting board. A reticle projector, mounted on the plotting board pen holder, is manually positioned by means of the plotting board drive tapes which also drive the encoders of an accumulating digitizer system. A photoelectric gap counting device can be substituted as an alternate for one of these encoders. The all-transistor digitizer system is equipped with manual switches for labeling of tracks, inserting frame numbers, etc., and has a versatile output format on seven hole paper tape. The paper tape with its track coordinate information is used as

the input for computer programs designed to calculate the particle physics evidenced by the track. (auth)

29168 LOW VOLTAGE He^3-FILLED PROPORTIONAL COUNTER FOR EFFICIENT DETECTION OF THERMAL AND EPITHERMAL NEUTRONS. William R. Mills, Jr. (Socony Mobil Oil Co., Inc., Dallas, Tex.), Richard L. Caldwell, and Ira L. Morgan. Rev. Sci. Instr., 33: 866-8 (Aug. 1962).

Neutron counters using He^3 gas at absolute pressures up to 10 atm were constructed and tested. The relative detection efficiency for thermal, epicadmium, and fast neutrons was measured as a function of pressure from 1 to 10 atm and compared with similar data from a boron trifluoride counter of the same size filled to a pressure of 65 cm of $B^{10}F_3$ gas. The ratio He^3/BF_3 increases approximately linearly with pressure for epicadmium and fast neutrons, reaching values of 26.6 and 21.6, respectively, at 10 atm He^3 pressure. This ratio shows a saturation effect for thermal neutrons, becoming 4.45 at 10 atm He^3 pressure. The gamma-ray response was found to be low with proper pulse shaping. High voltage plateau curves for 3- and 7-atm counters are given and indicate operating regions at least 100 v wide at a counter high voltage of about 1200 v. (auth)

29169 OBSERVATION OF NUCLEAR PARTICLE TRACKS IN THE ELECTRON MICROSCOPE. Wilbur Fiske Noyes (Cornell Univ., New York). Rev. Sci. Instr., 33: 878-9(Aug. 1962).

A fine-grained photosensitive layer was prepared for electron-microscopic radioautography. The layer was obtained by evaporating Ag at low pressure and temperature on electron microscope grids and sensitizing the silvered grids with Br_2. The resulting particles had an average diameter of ~ 100 A. The sensitivity of the layer to ionizing radiation was tested by sprinkling the grids with fine uranium acetate particles and examining the processed grids in an electron microscope. Short tracks and side spurs were observed which are probably due to alpha radiation from U^{235} and secondary electrons scattered from the silver, respectively. Tests with P^{32}-phosphate are also described. (D.L.C.)

29170 COOLING UNIT FOR LOW-TEMPERATURE THERMOSTATS. Stuart R. Gunn (Univ. of California, Livermore). Rev. Sci. Instr., 33: 880-1(Aug. 1962). (UCRL-6924-T)

A simple cooling unit using liquid nitrogen or dry ice is described. The unit comprises a copper rod soldered at the side of the bottom of a brass can and dipping in the bath. Heat transfer is by conduction along the copper rod, and its rate can be controlled by raising or lowering the rod. (D.L.C.)

29171 REDUCTION OF NOISE IN THE 6342-A PHOTOMULTIPLIER. Helmut Paul (Österreichische Studiengesellschaft für Atomenergie, Seibersdorf, Austria). Rev. Sci. Instr., 33: 881-2(Aug. 1962).

Attempts were made to improve the signal/noise ratio in the RCA 6342-A photomultiplier, with electrons focused on a plastic scintillator as the light source. A plot of noise rate and signal size vs potential on the focusing electrode showed that signal size is rather constant while the noise rate has a very pronounced minimum at an intermediate voltage. It is concluded that adjustment of the focusing electrode is important for low-noise applications of 6342-A and that part of the noise does not originate at the photocathode. (D.L.C.)

29172 THE MEASUREMENT OF PERSONNEL DOSES. Klaus Becker. Röntgen Bl., 15: 161-79(May 1962). (In German)

A survey is offered of the methods used for measuring the extreme load of radiation in compliance with the specifications of radiation safety regulations for persons occupationally exposed to radiation. The most significant sources of errors of film and rod dosimeters are briefly described, while general attention is directed to a few new processes. (auth)

29173 ERRORS CONNECTED WITH THE DEADTIME OF THE COUNTER IN FLUCTUATIONS OF THE SOURCE INTENSITY. A. M. Shenderovich. Ukrain. Fiz. Zhur., 7: 221-3(1962). (In Ukrainian)

A statistical analysis is made of dead-time corrections for a source intensity fluctuating with time when particles pass through the counter at intervals shorter than the dead-time. (R.V.J.)

29174 PROGRESS IN VACUUM MEASUREMENT DEVICES USING RADIOACTIVE MATERIALS. J. Moreau (Société Générale du Vide, Choisy-le-Roi, France). Vide, 17: 222-6(May-June 1962). (In French)

The "alphatron," a vacuum measurement device using radioactive sources, is described. Improvements to the standard device with respect to the radiation danger and to the construction are discussed. The principle of an alphatron is considered in some detail. The radiation source, the ionization chambers, and the measurement amplifier are discussed. (J.S.R.)

29175 NONDESTRUCTIVE AIR TIGHTNESS CONTROL OF SMALL SEALED ENCLOSURES. H. Piatti (Lignes Télégraphiques et Téléphoniques, Montrouge, France). Vide, 17: 250-5(May-June 1962). (In French)

It is well known that the flow of a leak can be evaluated if the increase of pressure caused by this leak in a given volume during a given time is measured. Using simple means such as a U-shaped manometer with a rough vacuum, it is possible to measure extremely small leaks from small sealed enclosures in a relatively short time (order of 10^{-6} mm Hg liter/sec in a few minutes). This method has the great advantage of being nondestructive and does not require a special gas inside the envelope (i.e., helium). It can be adapted for the control in mass production of crystal cans and of any other small-volume envelopes. This method is much more economical than any other current method. (auth)

29176 THE MECHANISM OF ELECTRICAL CLEANUP OF GAS IN THE HOT CATHODE IONIZATION GAGE. F. A. Baker (Standard Telephones and Cables, Footscray, France). Vide, 17: 256-66(May-June 1962). (In English)

A simple model that accounts in detail for the phenomenon of electrical cleanup of gas is proposed. This model emerges from a consideration, from the physical standpoint, of well established experimental data. A critical analysis is made of the glass cleanup characteristics and the mechanism of collisions of positive ions with solid surfaces is described. The gas cleanup model, gas recovery, and inert gas cleanup are explained in terms of ion neutralization at the solid surface followed by penetration of the solid lattice by the atom. (J.S.R.)

29177 SINGLE-FIELD ISODOSE CHARTS FOR HIGH-ENERGY RADIATION. An International Guide. Technical Reports Series No. 8. (International Atomic Energy Agency, Vienna). 1962. 214p. $3.00(IAEA)

Information is presented on over 2600 isodose charts which were measured or calculated by institutes and manufacturers all over the world. The charts discussed refer to gamma rays from Co^{60} and Cs^{137} teletherapy units and also to high-energy x rays and electron beams. The information is also classified according to the equipment model and the institution of origin. (M.C.G.)

29178 TEMPERATURE, ITS MEASUREMENT AND CONTROL IN SCIENCE AND INDUSTRY. VOLUME THREE. Charles M. Herzfeld, ed. PART 2. APPLIED METHODS AND INSTRUMENTS. A. I. Dahl, ed. New York, Reinhold Publishing Corporation, 1962. 1105p.

A total of 103 papers are included which were presented at the Fourth Symposium on Temperature, Its Measurement and Control in Science and Industry held in Columbus, Ohio, on March 27 to 31, 1961. The papers are segregated into sections dealing with thermoelectric thermometry, resistance thermometry, radiation thermometry, dynamic temperature measurements, automatic methods, miscellaneous methods, temperature sources, and thermal imaging techniques. (D.L.C.)

29179 RADIO-ACTIVE TRANSDUCER. S. Wanetick (to U. S. Atomic Energy Commission). U. S. Patent 3,024,364. Mar. 6, 1962.

A transducer is designed which is operable to measure the change in velocity of a moving object. The transducer includes a radioactive source having a collimated beam of radioactive particles, a shield which can block the passage of the radioactive beam, and a scintillation detector to measure the number of radioactive particles in the beam which are not blocked by the shield. The shield is operatively placed across the radioactive beam so that any motion normal to the beam will cause the shield to move in the opposite direction thereby allowing more radioactive particles to reach the detector. The number of particles detected indicates the acceleration. (AEC)

Materials Testing

Refer also to abstract 29304.

29180 ON THE OPTIMUM PARAMETERS OF X AND γ-RAY DEFECTOSCOPY. M. Nastase. Acad. rep. populare Romine, Inst. mecan. apl. "Traian Vuia," Studii cercetar. mecan. apl., 13: 517-27(1662). (In Rumanian)

Curves of the film blackening, obtained on the basis of experimental results, and a radiographic method for determining the absorption coefficient μ are given. Details are given as regards the optimum time of exposure, the respective curves being plotted for various thicknesses of material exposed to x and γ rays. Finally, observations and conclusions are presented, based on calculation and experimental data, concerning the radiation energy and the exposure of parts presenting various thicknesses. (auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

Refer also to abstracts 29241 and 29242.

(Refer also to abstracts 29274, 29275, 29276, and 29277 erroneously included under Health and Safety.)

29181 (DXRL-F4) FALLOUT IN NEW ZEALAND. First Quarter 1962. (New Zealand. Dominion X-Ray and Radium Lab., Christchurch). Aug. 1962. 7p.

Results of measurements of total beta activity in air filters and rain samples at Christchurch and Sr^{90} in rain and milk are given. No increase in atmospheric radioactivity was found. Three rain samples had activities between 30 and 60 $\mu\mu$C per liter, the remaining samples had activities less than 30 $\mu\mu$C per liter. (P.C.H.)

29182 (IDO-19310) THE ROLE OF METEOROLOGY FOLLOWING THE NUCLEAR ACCIDENT IN SOUTHEAST IDAHO. Norman F. Islitzer (Weather Bureau, Idaho Falls, Idaho). May 1962. 44p.

The nuclear accident at the Stationary Low Power Reactor No. 1 (SL-1) on January 3, 1961, presented the most severe test to date of meteorological support capabilities for such an occurrence at the National Reactor Testing Station. The activities of the Weather Bureau in providing responsible officials with the necessary meteorological information and interpretations during the emergency are discussed. The stagnant weather conditions following the accident provided a maximum potential air pollution episode. Meteorological evaluations of air concentrations and deposits of iodine-131 on the vegetation are presented. A deposition velocity for iodine-131 of 0.2 cm sec^{-1} over desert-type vegetation was computed. Computed dispersion patterns and emission rates of this isotope from the SL-1 are presented. The computed long-period average air concentrations, based on wind speed and direction statistics, are considerably less than measured values at greater distances from the source. This is apparently due to the confinement of the mountains forming the outline of the Snake River Plain. A volumetric-type calculation of air concentration appears to be more satisfactory. (auth)

29183 (SC-4722(RR)) FALLOUT REPORT: BETA-GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY, JANUARY THRU JUNE 1962. R. E. Womelsduff (Sandia Corp., Albuquerque, N. Mex.). July 1962. Contract [AT(29-1)-789]. 12p.

The gross beta-gamma radioactivity (expressed as micromicrocuries per cubic meter) of air samples collected at Sandia Laboratory during the first half of 1962 are reported. (auth)

29184 (TEI-776) INTERIM GEOLOGICAL INVESTIGATIONS IN THE U12e.04 TUNNEL, NEVADA TEST SITE, NYE COUNTY, NEVADA. W. L. Emerick, D. D. Dickey, and F. A. McKeown (Geological Survey, Washington, D. C.). July 1962. 47p.

The U12e.04 tunnel is a part of the U12e tunnel system, which has been driven southwestward beneath Rainier Mesa in the northern part of the Nevada Test Site. The U12e.04 tunnel was driven about S. 15°W. in zeolitic tuff of subunits E and F of Tunnel Bed 4 near the top of the lower member of the Indian Trail Formation (upper Miocene or lower Pliocene). Dolomite of Paleozoic age lies about 915 feet below the end of the tunnel; vertical cover over the end of the tunnel to the surface of Rainier Mesa is about 1,390 feet. The tuffs in the tunnel strike almost north-south and dip to the west. There are several normal northwest-trending faults with vertical to steep dips and small displacements. The predominant joint set strikes northwest and dips mostly vertically or steeply to the northeast. Petrographically and chemically the tuffs in the U12e.04 tunnel are similar to other tuffs of the Indian Trail Formation from the Nevada Test Site. The tuffs in the tunnel have an average porosity of 38.6 percent, dry bulk density of 1.46 g/cc (grams per cubic centimeter), grain density of 2.38 g/cc, water content of 20.7 percent by weight, Shore hardness of 25.1, and unconfined compressive strength of 4,400 psi (pounds per square inch). Separately, the tuffs from the chamber at the end of the tunnel have an average porosity of 36.8 percent, dry bulk density of 1.51 g/cc, grain density of 2.38 g/cc, water content of 20.0 percent by weight. Shore hardness of 27.2, and unconfined compressive strength of 4,500 psi. An NX-size cored hole was drilled from the surface of Rainier Mesa into the U12e.04 chamber. (auth)

29185 (TEI-787) HYDROLOGIC SIGNIFICANCE OF SIX CORE HOLES IN CARBONATE ROCKS OF THE NEVADA TEST SITE. Stuart L. Schoff and Isaac J. Winograd (Geological Survey, Washington, D. C.). July 1961. 99p.

Six core holes drilled in the northern part of Yucca valley, Nevada Test Site, penetrate carbonate rocks of Paleozoic age to depths of hundreds of feet. Although none reaches the regional water table, two enter a perched zone of saturation in marble. Several lines of evidence suggest that the carbonate rocks, if saturated, would yield water to appropriately construct wells penetrating them. Yields per well of 6 gpm, or more, may be expected. Wells need not be abandoned as futile solely because they have entered the carbonate rocks without finding water. (auth)

29186 (TEI-797) INTERIM GEOLOGICAL INVESTIGATIONS IN THE U12b.09 AND U12b.07 TUNNELS, NEVADA TEST SITE, NYE COUNTY, NEVADA. D. D. Dickey and W. L. Emerick (Geological Survey, Washington, D. C.). June 1962. Includes Section: GAMMA RADIOACTIVITY. Carl M. Bunker. 64p.

The U12b.09 and U12b.07 tunnels are a part of the U12b tunnel system which was driven northwestward beneath Rainier Mesa in the northern part of the Nevada Test Site. The rocks penetrated by the tunnel complex are bedded tuff, welded tuff, and tuffaceous sandstone of the Indian Trail and Piapi Canyon Formation of Eocene to Pliocene or younger age. The formations are about 1,900 feet thick in the vicinity of the tunnels. A gamma-radioactivity survey of the tunnel was made to obtain quantitative data on the radioactivity emitted by radioisotopes in the rock. Results indicate that gamma-radioactivity measurements can be used as a basis for distinguishing some of the units of the Indian Trail and Piapi Canyon in the vicinity of the U12b.07 tunnel. Aside from a decrease in radioactivity observed on the downward side of one fault in the U12b.09 tunnel no significant changes in radioactivity were noted. (auth)

29187 (TID-16359) STRONTIUM, MAGNESIUM, AND MANGANESE IN FOSSIL FORAMINIFERAL CARBONATES. Peter J. Wangersky (Yale Univ., New Haven. Bingham Oceanographic Lab.) and Oiva Joensuu (Miami, Fla. Univ. Marine Lab.). [1962]. Contract AT(30-1)-2882. 21p.

The fraction greater than 62 μ was separated from three deep sea cores, the calcium carbonate put into solution, and strontium, magnesium, and manganese determined in the calcium carbonate fraction. Strontium and magnesium

were relatively constant in this carbonate fraction, but manganese showed a significant increase with depth in core. (auth)

29188 (TID-16498) LETTER PROGRESS REPORT [ON ATMOSPHERE MONITORING] FOR JUNE AND JULY 1962. (General Mills, Inc., Minneapolis). Aug. 10, 1962. Contract AT(11-1)-401. 9p.

Progress is reported in the development and testing of jet impactors for collecting atmospheric particles at altitudes above 100,000 ft. Results are included from flight tests of direct flow air samplers for use at altitudes below 100,000 ft. (C.H.)

29189 (UCRL-13039) SOURCES OF INFORMATION ON ROCK PHYSICS. Current Literature, Final Report. Lorraine Burgin (Colorado School of Mines Research Foundation, Inc., Golden). Mar. 28, 1962. For Univ. of California Lawrence Radiation Lab., Livermore. Contract [W-7405-eng-48]. 115p.

A review was made of the current literature pertaining to the field of rock physics, rock mechanics, wave propagation, seismology, and other related subjects. An author index is included. (C.H.)

29190 PRESENT STATUS OF THE LEAD METHOD OF AGE DETERMINATION. J. Laurence Kulp, George L. Bate, and Wallace S. Broecker (Columbia Univ., New York). Am. J. Sci., 252: 345-65(June 1954).

The available results on the age of radioactive minerals as determined by the various isotopic ratios Pb^{206}/U^{238}, Pb^{207}/U^{238}, Pb^{207}/U^{235}, Pb^{207}/Pb^{206}, Pb^{206}/Pb^{210}, and Pb^{208}/Th^{232} are summarized. The probable sources of error are radon leakage, leaching and alteration, uncertainty in the isotopic composition of any common lead, chemical analysis, and instrumental techniques. With sufficient isotopic analyses on the common lead of an area, it is usually possible to make a precise correction for the common lead contribution to the isotopic composition of a radioactive mineral. Radon leakage can be measured under laboratory conditions and extrapolated to the integrated thermal history of the mineral. Chemical and instrumental errors are generally of second-order importance. The occurrence of leaching and alteration can be estimated from the comparison of the lead-lead with the lead-uranium ages. In the most ideal conditions, the uncertainty in the half life of U^{235} may be significant error. It is concluded that the 207/235 and 206/210 ages are the most reliable over the greater range of gelogic time. The 206/238 age is generally correct to 5 to 10 percent and supersedes the 207/235 age in accuracy for young minerals. The Pb^{208}/Th^{232} age is considered usable for minerals high in thorium content. The 207/206 age is the least reliable of all. Nomographs are presented which simplify the calculation of the age of a mineral from the isotopic ratio. (auth)

29191 THE AGE OF THE BALTORO GRANITE (KARAKORUM-HIMALAYA). Ardito Desio and Antonio Longinelli (Comitato Nazionale Energia Nucleare, Rome). Atti. accad. nazl. Lincei. Rend., Classe sci. fis., mat. e nat., 30: 437-48(Apr. 1961). (RT/GEO(62)3). (In Italian)

Several methods are attempted for determining the age of the Baltoro granite. The results of age determinations on the pleochroic halos of the biotite contained in two samples of granite and one of diorite are presented. The age of the Baltoro granite pluton is discussed. (auth)

29192 PRIMARY RESULTS ON DETERMINATION OF THE AGE OF SEVERAL MINERALS FROM THE ISLAND OF ELBA BY THE RUBIDIUM-STRONTIUM METHOD. G. Ferrara, B. Hirt, G. Marinelli, and E. Tongiorgi (Comitato Nazionale Energia Nucleare, Rome). Boll. soc. geol. ital., 80: 6p.(1961). (RT/GEO(62)2). (In Italian)

Ages of some rubidium-rich minerals (pollucite and lepidolite) from aplitic veins of the granodiorite of Monte Capanne (Elba) were determined by the Rb/Sr method. The results give a value around 7 m.y. and allow one to comment not only about the age of the Neogene sediments of Tuscany which contain pebbles of the magmatic rocks of Elba, but also about the relation of the intrusive and effusive phenomena of the post-orogenic volcanic phase connected with the subsidence of the western part of the Appennine chain. (auth)

29193 ANOMALOUS URANIUM-LEAD AGES. J. L. Kulp and W. R. Eckelmann. Bull. Geol. Soc. Am., 66: 767-8(June 1955).

The ages from the isotopic ratios Pb^{206}/U^{238}, Pb^{207}/U^{235}, and Pb^{207}/Pb^{206} do not agree with each other for a large fraction of the minerals studied. Many of these anomalous ages cannot be explained by radon leakage or errors in lead isotopic composition, and one possible cause may be removal of Pb from U minerals during recrystallization. Analysis of age data for several specimens of pitchblende and Pb minerals from the Lake Athabasca U district indicates that the true age is 1900 ± 40 million years and that there must have been more than one period of Pb removal. It is concluded that detailed study of the U and Pb isotopic content of a district can be used to evaluate the times of deposition and Pb removal. (D.L.C.)

29194 URANIUM-LEAD METHOD OF AGE DETERMINATION. PART I. LAKE ATHABASCA PROBLEM. Walter R. Eckelmann and J. Laurence Kulp. Bull. Geol. Soc. Am., 67: 35-54(Jan. 1956).

A suite of samples of pitchblende, clausthalite, and galena from various mines in the Lake Athabasca uranium province was subjected to isotopic and chemical analyses as well as radon-leakage measurements in order to obtain apparent ages from the isotopic ratios Pb^{206}/U^{238}, Pb^{207}/U^{235}, and Pb^{207}/Pb^{206}. Pb^{210}/Pb^{206} measurements were made to check equilibrium in the decay series. The apparent isotopic ages range from 220 to 1860 m.y. Alteration effects which might explain these anomalies are considered. Uranium leaching and radon leakage are inadequate to explain these anomalies. The diverse ages can be calculated on the hypothesis of a single period of pitchblende deposition at 1.90 ± 0.04 b.y. ago followed by two periods of exsolution of lead at about 1.2 and 0.15 b.y. This is consistent with the 207/206 ratio of the radiogenic lead in the clausthalite and galena which apparently formed at the times of recrystallization. However, the existing data do not preclude more than two periods of lead exsolution. An alternative hypothesis involving successive epochs of pitchblende deposition is more complex geologically and, without contemporaneous lead exsolution, cannot account for the observed isotopic relations. The recrystallization presumably requires only the elevation of the regional temperature to 150 to 300°C in the presence of water. The variable fractions of lead removed during the periods of recrystallization can be ascribed to variations in temperature and water content throughout the district. It is quite certain that (1) the initial uranium deposition occurred about 1.9 b.y. ago; (2) there have been at least two periods of lead exsolution; (3) one period of lead exsolution must have occurred subsequent to 0.22 b.y. ago; (4) another period of lead exsolution probably occurred about 1.2 b.y. ago; (5) alteration of subsurface pitchblende has been negligible during the last million years. These conclusions resulting from an intensive study of an important uranium province suggest some general principles which may be

applied to other areas. If samples are chosen to avoid recent weathering effects and if the radon leakage is measured, the remaining anomalies in the isotopic ages are probably due to partial lead removal at some time or times during the geologic history of the mineral. In all cases the 207/206 age will be closest to the true age but will be minimal. The true age can be approximated if a large number of samples from a given locality are studied with their associated common leads. Uranium minerals that give accordant isotopic ages have a known age and indicate the absence of significant regional thermal metamorphism following formation. (auth)

29195 LEAD AND SULFUR ISOTOPIC ABUNDANCES IN MISSISSIPPI VALLEY GALENAS. J. L. Kulp, G. L. Bate, W. U. Ault, and H. W. Feely. Bull. Geol. Soc. Am., 67: 123-4(Jan. 1956).

Galena specimens from the Mississippi River Valley show unusually large variations of 5 to 15% in the Pb^{207}/Pb^{206}, while the S^{32}/S^{34} ratio is essentially constant with a maximum variation of 2.7%. It is concluded that isotopic fractionation is not important in causing the variation in the lead isotopes. (D.L.C.)

29196 AGE OF THE BLACK HILLS GOLD MINERALIZATION. J. L. Kulp, W. R. Eckelmann, P. W. Gast, and D. S. Miller. Bull. Geol. Soc. Am., 67: 1557-8(Nov. 1956).

Two galenas from the Black Hills were isotopically analyzed for lead. One galena was associated with the gold quartz veins in the Homestake Gold Mine, while the other was from a lead vein in the Spokane Mine. The ages as calculated from the lead isotope data are 1500 to 1700 million years for the Homestake galena and less than 400 million years for the Spokane galena. It is concluded that there was a period of Precambrian mineralization in the Homestake deposit which was probably contemporaneous with the pegmatites of the southern Black Hills. (D.L.C.)

29197 URANIUM–LEAD METHOD OF AGE DETERMINATION. PART II. NORTH AMERICAN LOCALITIES. Walter R. Eckelmann and J. Laurence Kulp. Bull. Geol. Soc. Am., 67: 1117-40(Sept. 1957).

Many new isotopic age determinations by the uranium-lead method were made on most of the important North American localities from which primary uranium minerals were reported. With the aid of other published isotopic U-Pb age measurements, it was attempted to interpret the most probable age for each locality and to assign a reasonable uncertainty to that age. The recognition of differential lead loss, the relation of alteration to mineral type, the importance of radon leakage for young samples, and the potential analytical errors make it timely to conduct such a re-evaluation. Among the well established ages are: Spruce Pine district, North Carolina, 360 ± 20 m.y.; Portland, Connecticut, 265 ± 10 m.y.; Front Range, Colorado, 59 ± 5 m.y.; Black Hills, South Dakota, 1620 ± 20 m.y.; southeast Manitoba, 2650 ± 100 m.y.; Lake Athabasca, Saskatchewan, 1900 ± 50 m.y.; and the Wilber-force area, 1050 ± 20 m.y. Other probable ages are Bedford, New York, 350 m.y.; Colorado Plateau, 60 m.y.; Coeur d'Alene, 1200 m.y.; and Great Bear Lake, Northwest Territories, 1500 m.y. Although there may have been several regional metamorphic events in the Appalachian Province in the Precambrian, the post-Cambrian effects appear at only two periods centering on 260 and 360 m.y. The Grenville metamorphism appears limited to a narrow time interval about 1050 m.y. ago. The Front Range and Colorado Plateau uranium mineralization may have been one event occurring about 60 m.y. ago. (auth)

29198 DATING OF HOLOCENE DEPOSITS BY THE RADIOCARBON METHOD AND BY POWDER ANALYSIS. M. I. Neĭshtadt, A. L. Devirts, N. G. Markova, E. I. Dobkina, and N. A. Khotinskiĭ (Inst. of Geography and V. I. Vernadskiĭ Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1129-31(1962). (In Russian)

The age of the large Holocene deposits which are scattered throughout the territory of the USSR with the exception of the deserts and mountainous areas, was determined by C^{14} dating. Peat samples from single layers taken from the Berendeevo marshes, 100 km NE from Moscow were used for the tests. The location of the layers was determined by drilling, using the samples for a comparison of age measurements by stratigraphy and by the β activity of the radiocarbon with the help of a proportional counter. Results showed a marked increase of the age with depth. It was noted that the trunk of a pine tree lying at a depth of 2.25 to 2.50 m had the same absolute age of 4730 ± 190 years as peat samples taken from the same depth. Roots from the same depth but a certain distance away, lying in an old quarry showed an age of only 3630 ± 165 years. The systematic study of the age of individual layers by the radiocarbon method and comparison with data obtained from stratigraphic studies is an important tool for establishing the exact boundaries between the Pleistocene and Holocene deposits. (TTT)

29199 ORE LEADS AND ISOTOPES. John S. Brown. Econ. Geol., 57: 673-720(Aug. 1962).

Comparison of all published analyses of commercial lead ores, excluding Mississippi Valley deposits, shows that the ratio of thorium-derived (208) to uranium-derived lead (206 + 207) has remained constant at 1.13 to 1.14 for approximately 2 b.y. Mississippi Valley ores (1.10) generally are contaminated by about 1.5% uranogenic lead which is chiefly 206 and, therefore, constitutes about 7% of this component. By the use of this stable ratio (1.13) one may reconstruct any simple anomalous lead and, with the aid of 206/204 and 208/204 ratios appropriate to the indicated percentage of Pb^{204} more complex contamination likewise can be traced to its probable origins. Use of this method suggests that many minor veinlets of contaminated lead in the Canadian and Baltic shields and Australia are often of Mississippi Valley type and probably represent minor downward leakages from Paleozoic mineralizations formerly present in overlying strata. At Laisvall, Sweden, the original type is still preserved in a major deposit. Segregation of ore leads into post-Precambrian and Precambrian groups reveals a remarkable hiatus in isotopic values implying a long period when no lead ores were generated. This varies somewhat in position geographically, but generally corresponds to the erosion interval marking the end of Precambrian time. With respect to ore genesis, the data seem to demand that both geologists and geochemists revise drastically their present interpretations. Original ore genesis is related closely to long cycles of sedimentation but is not strictly syngenetic and may long antedate sedimentation, as in Mississippi Valley ores. Igneous activity and metamorphism often have redistributed ores and changed their thermal characteristics but without isotopic modification beyond simple homogenization. (auth)

29200 ISOTOPIC DATING AND THE GEOLOGIC TIME SCALE. J. Laurence Kulp (Columbia Univ., New York). Geol. Soc. Am. Spec. Paper 62, 609-30(1955).

The intensive research on isotopic methods of age determination at a number of laboratories has produced new

methods, advances in experimental techniques, and many additional measurements. These developments are reviewed with particular reference to the effect of the new age determinations on the geologic time scale. The age of the planet now appears to be about 4.5 billion years, and the oldest rocks about 3.5 billion. A large number of new measurements on Precambrian rocks provide a basis for interregional correlations. In general the post-Cambrian time scale remains unchanged, but new determinations certify the older ones and reduce the errors involved. The major problem of correlating the isotopic dates with the sedimentary column remains. The most promising leads in the solution of this problem lie in absolute age determination of intercalated volcanics and carbonaceous shales. Ages obtained from the various uranium-lead isotope ratios on pegmatite uraninite or samarskite are generally concordant, provided a correction for radon leakage is applied and the proper common lead correction is made. Under such conditions it is highly probable that a true age has been obtained. Where the apparent ages derived from these ratios do not agree, recrystallization with consequent lead loss is indicated. In the case of pitchblendes similar criteria apply; however, the ease of recrystallization, transportation, and redeposition complicates the interpretation of the apparent age derived from the measurements. Rubidium-strontium ages were reported which appear too high. Reasons for these anomalies are suggested. The potassium-argon method was shown to be feasible during the last year. This may become the most useful of all isotopic chronometers. (auth)

29201 Pa^{231}/Th^{230} DATING AND O^{18}/O^{16} TEMPERATURE ANALYSIS OF CORE A254-BR-C. J. N. Rosholt, C. Emiliani, J. Geiss, F. F. Koczy, and P. F. Wangersky (Univ. of Miami, Fla.). J. Geophys. Research, 67: 2907-11(July 1962).

O^{18}/O^{16} paleotemperature analysis of a core from the central Caribbean Sea yielded a temperature curve similar to those obtained from other cores in the same area. Pa^{231}/Th^{230} dating of significant temperature events yielded a set of dates that were identical, within the limits of error of the analytical methods and of the stratigraphic correlations, to the set of dates previously obtained from other Caribbean deep-sea cores. (auth)

29202 RELATIONSHIPS OF LEAD ISOTOPES AMONG GRANITES, PEGMATITES, AND SULFIDE ORES NEAR BALMAT, NEW YORK. Bruce R. Doe (Carnegie Institution of Washington, Washington, D. C.). J. Geophys. Research, 67: 2895-2906(July 1962).

The isotopic composition of lead from potassium feldspars of granite and pegmatites and from galena of near-by sulfide ores near Balmat, New York, was measured. Mineral ages were measured by the Rb–Sr and K–Ar methods on potassium feldspars and associated micas. The best Rb–Sr age was 1100 m.y., and the K–Ar age was in agreement at 1000 m.y. There was no evidence of any metamorphism of these rocks subsequent to the billion-year event. Lead in the feldspars was slightly more radiogenic than the lead in the galena. The ores could not have been derived from the near-by igneous rocks unless lead had been added to the potassium feldspars of the igneous rocks subsequent to the formation of the ores. The potassium feldspars and ore galenas each had lead with isotopic constitutions that lay close to the normal growth curves for conformable lead ores. In addition, the model lead ages for the potassium-feldspar leads of these syntectonic granites and pegmatites were in fair agreement with the radioactive ages. The reproducibility of the lead isotope measurements was established from sixteen analyses of a shelf lead and duplicate determinations of each sample. The data were corrected for discrimination by the electron multiplier by means of analyses of gravimetric mixtures of enriched isotopes of Pb^{206} and Pb^{208}. (auth)

29203 EXCESS RADIOGENIC ARGON IN PYROXENES. S. R. Hart (Carnegie Institution of Washington, Washington, D. C.) and R. T. Dodd, Jr. J. Geophys. Research, 67: 2998-9(July 1962).

In a locality whose age is known from U–Pb dating to be 1050 to 1150 million years (m.y.), K–Ar dating of two pyroxene samples yields apparent ages of 1500 to 10,400 m.y. Concordant K–Ar dating of two hornblende samples yields ages that agree more closely with the U–Pb results, namely 900 and 1000 m.y. The high apparent ages of the pyroxene samples are surmised to result from the inclusion of excess Ar^{40} in the pyroxenes during their initial crystallization or during a later recrystallization. It is noted that loss of K at some time during the history of the pyroxenes, without simultaneous loss of Ar, could also raise the apparent age; the probability of such an occurrence is considered to be very slight. (T.F.H.)

29204 INTERPRETATION OF LEAD ISOTOPE ABUNDANCES. J. R. Richards (Australian National Univ., Canberra). Nature, 195: 590-1(Aug. 11, 1962).

Comments are made on the importance of proper allowance for mass-spectrometric tail effects and the need for considering the applicability of the sample to the model before placing reliance on a model age. Examinations were made on variations between laboratories in measurements on separate fractions of one sample of pulverized material. Where comparison was possible, a clear correlation between size of mass-spectrometric tail and deviation from what appeared to be a close approximation to the correct answer was made. It was also found that by careful attention to detail, it was possible to obtain from an instrument with 6 in. radius of curvature, without the need for making tail corrections, results comparable with those previously obtained by others on a 12 in. instrument. (P.C.H.)

29205 NEW AGE DETERMINATIONS BY THE LEAD METHOD. J. Laurence Kulp, George L. Bate, and Bruno J. Giletti (Columbia Univ., New York). Proc. Geol. Assoc. Can., 7: 15-24(May 1955).

Ages of a number of radioactive minerals were determined from Pb^{207}/Pb^{206}, Pb^{206}/U^{238}, Pb^{207}/U^{235}, and Pb^{206}/Pb^{210} ratios. Values obtained for minerals from classic localities agree well with those reported by other investigators. Major attention was given to the anomalies of the ages of a given mineral computed from the various possible isotope ratios. The development of the Pb^{210} method adds greatly to the fund of data required to obtain accurate ages. The 206/210 age is essentially independent of uranium leaching or radon leakage. The latter is a significant factor in 206/238 and 207/206 ratios and must be measured experimentally to evaluate ages from these ratios. It appears that throughout most of the span of geologic time the 207/235 and 206/210 ages are the most reliable if lead loss has not occurred. The 206/238 supersedes the 207/235 age in accuracy for very young minerals. For young minerals the 207/206 age does not merit the reliability ascribed to it by earlier investigators. (auth)

29206 ABSOLUTE AGE OF EARLY PRECAMBRIAN ROCKS IN THE BIGHORN BASIN OF WYOMING AND MONTANA, AND SOUTHEASTERN MANITOBA. P. W. Gast, J. L. Kulp, and L. E. Long. Trans. Am. Geophys. Union, 39: 322-34(Apr. 1958).

Age determinations on nine samples from the southeastern part of the Beartooth Range, Montana, indicate that the absolute age of the pegmatites and granitic gneisses of this area is 2750 ± 150 m.y. A single determination from the northern Bighorn Mountains, Wyoming, suggests a similar age for this portion of the Precambrian basement. Several samples from the Winnipeg River–Johnston Lake area of Manitoba indicate an absolute age of 2650 ± 150 m.y. for both the pegmatites and gneisses. A similar age was found for a muscovite from the northwestern angle region of Minnesota. Rubidium-strontium ages were found to be more consistent than potassium-argon ages. Argon loss from micas was commonly as great as 15%. (auth)

HEALTH AND SAFETY

Refer also to abstract 28661.

29207 (AEET/RMS/7) CHEMICAL DOSIMETRY. A Bibliography. (India. Atomic Energy Establishment, Trombay). May 1962. 116p.

References (725) are given to U.S. and foreign patents, books, bibliographies, reports, and journals published from 1927 to December 1961. The subjects covered include: ferrous sulfate, ceric sulfate, and oxalic acid dosimetry; chlorinated hydrocarbon, dye, polymer, gel, gaseous, chloral hydrate, benzene and benzoate, and fluorescent systems; and radiation chemistry of ferrous sulfate, ceric sulfate, dye, and chlorinated hydrocarbon solutions. A separate author index is given. (P.C.H.)

29208 (ANL-6584) SMEAR STUDY OF D205 (CHEMICAL ENGINEERING BUILDING). Frank P. Marchetti (Argonne National Lab., Ill.). July 1962. Contract W-31-109-eng-38. 23p.

The smear study shows that at least 80% of the floor-smear surveys which were made in a clear area of the Chemical Engineering Building during the course of this study indicated radioactivity equal to or less than 10 d/m/ft^2 alpha and equal to or less than 200 d/m/ft^2 beta-gamma. The smear survey technique is excellent for use in a high-hazard area, such as a Pu facility. It is capable of detecting as little as 10 d/m/ft^2 of alpha contamination with a high degree of confidence. The smear survey is also useful in determining whether the radioactivity on an item is low enough so that it may be removed from an active area. (auth)

29209 (HW-SA-2713) SIZE ANALYSIS OF PARTICULATES FOUND IN AIR AT HANFORD PLUTONIUM FABRICATION FACILITIES. J. M. Selby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Aug. 9, 1962]. Contract AT(45-1)-1350. 12p.

A study was made on the characteristics of radioactively contaminated air at Hanford work locations. One of the main objectives in this study is to define the size of particular air contamination in plutonium handling facilities. In addition to characterizing the particulate contamination, it is desirable to know the normal background particle size distribution. Data are summarized on general particle size distribution and radioactive particle distribution at two Hanford plutonium fabrication facilities. (auth)

29210 (NASA-TN-D-1383) RADIATION EXPOSURE IN SUPERSONIC TRANSPORTS. Trutz Foelsche (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Aug. 1962. 36p.

Radiation exposure levels for flight personnel and passengers in supersonic transport operations at altitudes up to 75,000 feet (23 km) are estimated on the basis of recent data, and compared with the maximum permissible exposure levels for normal peacetime operations recommended in 1960 in the guides of the Federal Radiation Council. (auth)

29211 (NYO-4817) AIR CLEANING STUDIES, PROGRESS REPORT FOR JULY 1, 1959 TO JUNE 30, 1960. Richard Dennis, Leslie Silverman, Yoichi Takashima, Frederick L. Muller, Felix Stein, Joseph J. Fitzgerald, and Philip Drinker (Harvard Univ., Boston. Air Cleaning Lab.). July 13, 1962. Contract AT(30-1)-841. 104p.

With this is bound NYO-4818.

Evaluation of a commercial jet scrubber was continued with fume, dust, and vapor removal studies. Research programs were continued on design of gas cleaning apparatus for low-level radioactive waste incinerators, development of collectors for radioactive iodine, studies on factors determining the behavior of iodine aerosols, and compilation of site experience on air and gas cleaning methods and costs. A special research project on the performance of adhesive coated Neva-Clog screens was completed during this period. Evaluation of jet scrubbing as a means of containing effluents from the simulated evaporation and calcination of liquid radioactive wastes was continued. A tentative design specification was submitted for a 25-lb-per-hr, low-level, radioactive waste incinerator. The development of diffusion boards serving both as containment structure and aerosol collector and the investigation of foaming agents for static and dynamic encapsulation of radioactive aerosols are discussed. (auth)

29212 (ORNL-TM-346) HAZARDS ANALYSIS OF FUEL HANDLING FACILITIES. E. D. Arnold and J. P. Nichols (Oak Ridge National Lab., Tenn.). Aug. 24, 1962. Contract [W-7405-Eng-26]. 30p.

Accidental releases of radioactive material at the Oak Ridge National Laboratory resulted in the establishment of building and ventilation design criteria and the requirement for a hazards evaluation for those facilities which contain or handle radioactive materials of physiological hazard greater than that equivalent to one gram of Pu-239. A quantitative method for estimating the hazards associated with the maximum credible accident in a radiochemical facility were developed. The maximum credible accidents are chemical or nuclear explosions which disperse radioactive aerosol and gases into ventilation streams which exhaust to the atmosphere. Approximate physical properties of these aerosols and gases were combined with the efficiency of ventilation cleanup devices and meteorological correlations to evaluate the hazard to the environment. (auth)

29213 (OTO-60-1) KIWI-A REACTORS—PRIME AND THREE. Off-Site Radiological Safety (Final) Report. (Public Health Service, Las Vegas, Nev.). 1960. 49p.

A summary of off-site radiological safety activities during the operating of KIWI-A reactors, Prime and Three is presented. Equipment and procedures are described and radiation measurement results are given. (J.R.D.)

29214 (TID-7627) SEVENTH AEC AIR CLEANING CONFERENCE, OCTOBER 10-12, 1961, HELD AT BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK. (Division of Reactor Development, AEC and Harvard Univ., Boston. Air Cleaning Lab.). 601p.

Papers presented at the Seventh AEC Air Cleaning Conference are given. Separate abstracts were prepared for each of the 34 papers. (M.C.G.)

29215 (TID-7627(p.8-23)) A DESCRIPTION OF THE BNL RESEARCH REACTOR ENVIRONMENTAL AIR CONTROL, ALARM AND MONITORING SYSTEM. Carl H. Distenfeld (Brookhaven National Lab., Upton, N. Y.).

The use and functions of the Brookhaven Research Reactor air monitoring and control system are described. Emphasis is given to the automatic corrective air conditioning control and personnel warning features of the system as a reference in methodology and design for future installations. (auth)

29216 (TID-7627(p.24-42)) SUMMARY OF FISSION PRODUCT ADSORPTION WORK AT BNL. Frank J. Salzano (Brookhaven National Lab., Upton, N. Y.).

A summary is presented and references given on work completed and under way at Brookhaven National Laboratory on the adsorption of fission products on graphite and activated charcoal. Results on the dynamic behavior of xenon and krypton on small charcoal adsorption beds is described. The behavior of xenon on graphite at high temperatures is discussed and some preliminary data on the adsorption of iodine on graphite are presented. (auth)

29217 (TID-7627(p.43-57)) AIR SAMPLING FILTER PAPER RETENTION STUDIES USING SOLID PARTICLES. Samuel Posner (New York Operations Office. Health and Safety Lab., AEC).

The collection characteristics of filter media as they are used for air sampling were studied using uranine dye. Comparisons were made with previous results using dioctyl phthalate (DOP). The aerosol generating system was patterned on a system developed by Whitby of the University of Minnosota. Aerosols of two sizes were used. Results are presented in graph and table form. (M.C.G.)

29218 (TID-7627(p.58-73)) THE REMOVAL OF GASEOUS CONTAMINANTS FROM AIR WITH A SORBANT INJECTION SYSTEM. R. Lopes Cardozo and P. Dejonghe (Brussels. Centre d'Étude de l'Énergie Nucléaire).

It is shown that a sorbant injection system can be used as a means of cleaning gases from contaminants when low or intermediate decontamination factors are allowed, for instance in closed circuits. The sorbant injection system, in its simplest form, is composed of a certain pipe length with a sorbant feed system at the head-end and a cyclone, to remove the sorbant from the gas stream, at the tail-end. It is shown that decontaminations of the order of 99% are easily obtainable. (auth)

29219 (TID-7627(p.74-83)) THE FILTER TEST PROGRAM, AN INSTALLATION MANUAL, AND FILTER RESEARCH. Humphrey Gilbert (Atomic Energy Commission, Washington, D. C.).

Testing experience with high-efficiency filter units is described. Actions to assure the performance of high-efficiency systems are discussed. (M.C.G.)

29220 (TID-7627(p.84-101)) EVALUATION OF HIGH-EFFICIENCY AIR FILTER SYSTEMS. James A. Young (Naval Research Lab., Washington, D. C.).

The in-place evaluation of high-efficiency air filters is discussed. The method used consists of the generation of an aerosol of dioctyl phthalate upstream of the filter. The aerosol concentration ahead of the filters and that down stream is detected and measured by the use of a light-scattering meter. If the downstream sample has an aerosol concentration equal to, or less than, 0.05% of the upstream sample, the system is considered acceptable. Examples of the use of this technique are described. Recommendations are given for the design of filter systems. (M.C.G.)

29221 (TID-7627(p.102-15)) ELECTROSTATIC PRECIPITATORS FOR NUCLEAR SUBMARINES. Wendell L. Anderson (Naval Research Lab., Washington, D. C.).

Electrostatic precipitators for the control of aerosols in nuclear submarine atmospheres are described. Measurements of the atmosphere composition as well as effectiveness of the precipitators under operational conditions are included. (auth)

29222 (TID-7627(p.116-26)) LIFE-LOADING TESTS ON CERTAIN FILTER MEDIA. F. E. Adley and D. E. Wisehart (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A study is reported of six selected roughing filter media and a high-efficiency medium to determine their life-loading characteristics. Accelerated life tests using a natural dust test aerosol were designed and performed to simulate anticipated operating conditions in proposed reactor confinement ventilation systems for which these filters were being considered. Test findings were correlated with actual confinement system performance. Reasonable agreement is noted. Test data indicated the inadvisability of using roughing filters due to the increased pressure drop of the high-efficiency filters per unit of loading and to the relatively difficult task of roughing filter changes. (auth)

29223 (TID-7627(p.127-37)) TURBULENT DEPOSITION IN SAMPLING LINES. L. C. Schwendiman and A. K. Postma (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The significance of turbulent deposition of particulates in sampling lines is discussed. Data are presented which permit the deposition to be estimated. The particulate material used in most of the experiments was fluorescent grade ZnS. The powder-laden air was passed into a vertical pipe. The number of particles of a given size deposited on a unit area per unit time of those in the unit volume of gas passing though the pipe were measured. Deposition was found to be extremely sensitive to particle size and sampling velocity. (M.C.G.)

29224 (TID-7627(p.138-55)) PROGRESS REPORT OF THE HIGH VOLUME ELECTROSTATIC SAMPLER (HIVES). Alfred W. Western and R. Frank Grossman (Public Health Service, Idaho Falls, Idaho).

The high volume electrostatic sampler (HIVES) was developed for sampling large volumes of air at 1000 to 2000 cfm for trace amounts of radioactive contaminants. A detailed description of the two-stage electrostatic precipitator and its component parts is given. Theoretical collection efficiencies of two-stage electrostatic precipitators are discussed and efficiency calculations are made using two different approaches. Field tests are described and the methods of determining actual collection efficiencies are discussed. Two methods were used to determine the HIVES collection efficiency and both methods indicated efficiencies of greater than 99.9% at a flow rate of 1000 cfm. (auth)

29225 (TID-7627(p.156-67)) AIR FILTRATION OF MICROBIAL PARTICLES. Herbert M. Decker (Chemical Corps, Fort Detrick, Md.).

The efficiency of filters in biological air cleaning was studied. Four types of filters were considered: roughing, medium-efficiency, high-efficiency, and ultrahigh efficiency. Air washing and electrostatic precipitation methods of air cleaning were also investigated. It was found that, if the incoming air must be kept entirely bacterial free, then a roughing filter followed by an ultra-high efficiency filter is the system of choice. Normally, however, cleaning the air to that extent was not necessary and a lower efficiency filter was adequate. (M.C.G.)

29226 (TID-7627(p.168-86)) EQUIPMENT AND PROCEDURES FOR STACK GAS MONITORING AT ORNL. J. F. Manneschmidt (Oak Ridge National Lab., Tenn.).

Routine monitoring of gaseous waste at ORNL was started in 1956, when manually operated tape monitors were placed on each of the three process stacks. In 1959 the development of a monitoring system was intensified and certain improvements were made to the Principal

Stack. These included the addition of a step-moving tape monitor for better particulate detection, a charcoal trap monitor for adsorbable-gas detection, and an ion chamber detector in the off-gas system discharge, which carries the bulk of activity released into the stack. Inventory-type samplers, consisting of a filter and a charcoal cartridge, were placed on all stack samplers for the purpose of estimating stack activity discharges. In 1961 an experiment, using a triple sample withdrawal probe with tape monitors, was initiated at the Principal Stack to establish the criteria for a new sample withdrawal system. A temporary in-stack sampler was installed to replace the less efficient external samplers and design is under way on a permanent installation which may be operated with greater simplicity and safety. An improved tape monitor which will give both beta/gamma and alpha detection, and which has many other advanced features, is planned for future use on the stack and on the ducts. The filter-charcoal cartridges will then be used on the smaller tributaries. A gross-gamma monitor, consisting of scintillation detectors mounted at the top of the stack, is in the concept stage. (auth)

29227 (TID-7627(p.187-214)) PROCEDURES FOR TESTING HIGH PERFORMANCE FILTERS AT ORNL. R. W. Schneider (Oak Ridge National Lab., Tenn.).

A procedure for assuring the quality of filters is being studied. Testing of new filters prior to stocking and testing filter installations are discussed. (M.C.G.)

29228 (TID-7627(p.215-21)) HIGH EFFICIENCY FILTER PROGRAM [AT] NATIONAL REACTOR TESTING STATION. Bruce J. Held (Idaho Operations Office, AEC).

Improvements are being made in the high-efficiency filter program. A smoke photometer is being used for in-place testing. The necessity of using high efficiency filters in laboratory fume hoods was questioned and studied. It was concluded that high-efficiency filters are too often used indiscriminately for all radioactive particulate filtration when less efficient filters would be more than adequate. (M.C.G.)

29229 (TID-7627(p.222-41)) THE EVALUATION OF RADIOACTIVE RELEASES FROM CHEMICAL PLANTS. E. D. Arnold, A. T. Gresky, and J. P. Nichols (Oak Ridge National Lab., Tenn.).

Recent accidental releases of radioactive material at ORNL resulted in the establishment of building and ventilation design criteria and the requirement for a hazards evaluation for those facilities which contain radioactive material of physiological hazard greater than that equivalent to one gram of Pu^{239}. A quantitative method for estimating the hazards associated with the maximum credible accident in a radiochemical facility was developed. The maximum credible accidents in such facilities are chemical or nuclear explosions which disperse radioactive aerosol and gases into ventilation streams which exhaust to the atmosphere. Approximate physical properties of these aerosols and gases were combined with the efficiency of ventilation cleanup devices and meteorological correlations to evaluate the hazard to the environment. The method of evaluation was applied to ORNL radiochemical facilities, which were modified to meet the new containment criteria, to demonstrate the acceptably low personnel exposure and ground contamination that would result from the maximum credible accident in each facility. (auth)

29230 (TID-7627(p.242-62)) REMOVAL OF IODINE FROM GAS STREAMS. Robert E. Adams and William E. Browning, Jr. (Oak Ridge National Lab., Tenn.).

The efficiency of activated charcoal, silver, and copper surfaces for adsorption of iodine vapor was studied under various conditions and in several gas systems. Iodine vapor is removed from air at 25°C by activated charcoal with efficiencies as high as 99.999+%. Copper and silver-plated copper ribbon exhibit efficiencies up to 98 to 99%. In steam-air systems over the temperature range of 75 to 118°C activated charcoal has an average iodine removal efficiency to 99.9% for moderate gas velocities. In helium at a temperature of 325°C, the various charcoals exhibit iodine retention efficiencies varying from 16 to 99.99+%. A special impregnated charcoal, Whetlerite ASC, exhibits efficiencies of 99.99+% for iodine vapor up to temperatures of 550°C in helium. (auth)

29231 (TID-7627(p.263-83)) FUEL ELEMENT DECOMPOSITION PRODUCTS. G. W. Parker, G. E. Creek, and W. J. Martin (Oak Ridge National Lab., Tenn.).

Reactor fuel types and their related hazards are discussed. Topics covered include: fission product release from uanium and uranium alloys, fission product release and particle emission from UO_2 fuel materials, and chemical states of released fission products. (M.C.G.)

29232 (TID-7627(p.284-307)) THE HANFORD REACTOR CONFINEMENT PROGRAM. H. W. Heacock and C. E. Jones (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A project that provides facilities for confining the fission product release from a nuclear incident was completed for the eight existing Hanford reactors. Similar facilities are also being constructed into the New Production Reactor. The existing facilities are reviewed and are compared to those planned for NPR. The testing program supporting design and operating experience with the existing system are summarized. Activated charcoal was selected as the media for the halogen filters. Roughing filters were deleted from the system based on results of the filter life tests. In-place DOP testing of the absolute filters following their installation insures a high degree of filtration efficiency. Functional tests of the system that simulate a burning irradiated fuel element were satisfactory. Such tests resulted in confinement zone pressures being held 0.3 inch water gage negative with respect to atmospheric pressure. In practice it is anticipated the system will remove 99.9% of the particulates, about 95% of the halogens, but none of the noble gases. (auth)

29233 (TID-7627(p.308-26)) RECENT AIR CLEANING DEVELOPMENTS AT ARGONNE NATIONAL LABORATORY. C. L. Cheever (Argonne National Lab., Ill.).

Studies on filtration and characterization of the plutonium combustion fume are reviewed. Tests were conducted in a plutonium system glove box. Individual particles with an average size of 0.016 μ were observed in fume agglomerates, some of which contained thousands of particles. PuO_2 fume penetration of the first high-efficiency filter media in series ranged from 0.005 to 0.9%. (M.C.G.)

29234 (TID-7627(p.327-48)) IODINE COLLECTION STUDIES—A REVIEW. R. Dennis, L. Silverman, and F. Stein (Harvard Univ., Boston. School of Public Health).

Results of past iodine collection studies conducted by the Harvard Air Cleaning Laboratory under AEC contract are reviewed briefly. Performance data not previously reported are given for metal and mineral collectors (fibrous and granular) under a variety of operating conditions. Major test objectives are to determine which media afford optimum removal of radioactive iodine from laboratory, process, or reactor gas streams. Although activated carbon, silver nitrate-coated Berl saddles, and caustic

scrubbers were used successfully in certain applications, none of these meet all of the following requirements: 90 to 99.9% removal of iodine, low resistance to air flow, extended service life—up to two years, operational at temperatures up to 300°C, corrosion resistant, and noncombustible. Screening tests indicate that bronze, copper, and silver plated-copper meshes are efficient collectors for high iodine concentrations, >1 Mg/M^3, but erratic in performance when concentrations are low, 10^{-6} Mg/M^3. Variability with low iodine concentrations is apparently related to the physical state of iodine, i.e., molecular, chemically complexed, or particulate-adsorbed. Data suggest that iodine aerosols will differ greatly in the field, depending upon the physical and chemical properties of other aerosol components, operating temperatures, and gas retention time prior to treatment. In order to designate by what mechanisms iodine is removed by a certain collector rigorous aerosol definition is required. Current testing is designed to determine insofar as possible the behavior of molecular and particulate-adsorbed iodine by analysis of iodine gas streams for particle size and number. All iodine generation techniques used in the studies will be evaluated. (auth)

29235 (TID-7627(p.349-71)) STUDIES OF SHOCK WAVE CLEANING OF HIGH TEMPERATURE FILTER MEDIA. C. E. Billings, R. A. Gussman, and L. Silverman (Harvard Univ., Boston. School of Public Health).

Early laboratory (shock tube) and field (NTS) studies demonstrated that deposited dust can be removed from all types of particulate filters by low intensity shock waves. Fraction of dust dislodged was found to be equal to 1.26 $LP^{0.4}/D^{0.8}$. (L = grams deposited dust per sq ft filter, P = overpressure, psi, D = filter depth, 6 or 12 inches). Subsequent tests with deep bed filters of refractory mineral wool in a 6 in. shock tube study indicated resistance could be restored to near original clean values by shock waves. Resistance reduction was proportional to $2P^{\frac{1}{2}}$ for shock wave pressures created with burst diaphragms in the range of 3 to 16 in. Hg. These results were applied to a 1600 cfm mineral wool filter pilot plant unit for collection of high temperature metallurgical furnace fumes. Bursting diaphragm and explosive cartridges were used to generate the shock waves. Slow attrition of mineral wool fiber due to shock wave effects led to stainless steel wool as a high temperature medium. Results obtained with stainless steel wool in laboratory and pilot scale studies on metallurgical fume are described. Earlier work with mineral wools is reviewed, and results of screening several high temperature filter media cleaned by shock waves are presented. Methods of producing shock waves for filter cleaning applications, and shock wave dislodged particle disposal systems are described. A prototype high temperature (1000°F) stainless steel wool filter suitable for industrial, nuclear, and power plant stack gas cleaning is being tested and preliminary results are presented. (auth)

29236 (TID-7627(p.372-89)) FACTORS IN CONDENSATION NUCLEI COUNTERS FOR MEASUREMENT OF AEROSOL AGGLOMERATION. Robert A. Gussman, Charles E. Billings, and Leslie Silverman (Harvard Univ., Boston. School of Public Health).

Some suggested methods for producing aerosol agglomeration in flowing gas streams are presented. An outline of requirements for a continuous particle number concentration instrument to be used for assessing dynamic agglomeration is included. A brief discussion of condensation nuclei counters for measuring aerosols is given. Since condensation nuclei can be grown in a supersaturated atmosphere to droplets of a homogeneous size, uses of this phenomena for dynamic particle concentration measurements on sub-micron particles are discussed. Diluter systems are described for the reduction of concentrations found in industrial aerosols (10^6-10^{11} p/ml) to levels useable in aerosol counters (10^5 p/ml). (auth)

29237 (TID-7627(p.390-405)) DIFFUSION BOARD CONTAINMENT CONCEPTS AND FOAM ENCAPSULATION STUDIES—A PROGRESS REPORT. L. Silverman, M. Corn, and F. Stein (Harvard Univ., Boston. School of Public Health).

Preliminary results in the development of treatments for gases and particulates released from reactors or nuclear processes within containment or confinement structures are given. Progress is reported on a diffusion board which will serve as a porous filtration and adsorption membrane for released particulates and halogens. This board must resist steam, pressure, and shock. Development of foam encapsulation of gases and particulates for use inside containment vessels is also described. Reductions of concentrations of released contaminants by factors of 10 or more were obtained with 0.074 u and greater size aerosols. This reduction was also obtained with iodine vapor. (auth)

29238 (TID-7627(p.406-15)) ECONOMIC SURVEY OF AIR AND GAS CLEANING OPERATIONS WITHIN THE AEC. M. W. First, L. Silverman, J. J. Fitzgerald, C. E. Billings, and R. Dennis (Harvard Univ., Boston. School of Public Health).

The Harvard Air Cleaning Laboratory is conducting an economic survey of AEC air cleaning costs over the past several years. The basic data to be supplied by the operating sites are still incomplete but a number of conclusions were reached from the information already on hand. The type of equipment to select and how to employ it with respect to air flow rate, pressure drop, etc., so as to achieve economy of operation are discussed. Since high performance cleaners are those highest in purchase price, opportunities for effecting substantial savings in the original installation cost are likely to be rather restricted. In most cases, however, the capital cost, distributed over the estimated life of the equipment, represents but a small part of the total annual cost. Therefore, it is in the operating phase that the greatest opportunity for minimizing air cleaning costs exists. Analysis of annual operating costs for AEC filters showed that capitalization costs are less than 20% for most installations; but filter replacement costs (material and labor) represent 65% or more of the total. For the typical commercial throw-away air filter that is frequently used as a prefilter for the AEC high-efficiency filter, annual capitalization costs are only 10 to 12% of the total; but labor costs for replacement of filter media average about 40% and the purchase of new filters, about 25%. Although the total material and labor cost for filter media changes is the same for prefilters and final filters (65%), the purchase cost of the replacement media is 60% of the annual cost in the case of the AEC filter installations but only 25% for the prefilters; showing how completely a single expensive replacement item can dominate the total cost picture. Fractional cost breakdowns of this nature suggest ways in which annual air filtration costs can be minimized. (auth)

29239 (TID-7627(p.416-60)) RADIOACTIVE WASTE INCINERATOR DESIGN AND OPERATIONAL EXPERIENCE—A REVIEW. R. Dennis and L. Silverman (Harvard Univ., Boston. School of Public Health).

Since 1950 several attempts were made to design incineration and gas cleaning equipment for the disposal of solid, combustible radioactive wastes. The main objective was to reduce the total volume of contaminated wastes so that over-all cost for incineration, ash disposal, and ultimate storage would be less than existing costs for handling, storing, transporting, and burying the bulk waste. However, recovery of fissionable materials also led to special incinerator design. Incineration experience at several AEC sites is reviewed, including basic design requirements, operational problems, and economic considerations. Failure of most devices to compete economically with other means of waste disposal was due principally to the high cost of gas cleaning systems although structural failings in incinerator design and erratic combustion were also trouble sources. Performance data are also furnished for two incineration systems in current use and reportedly operating successfully in terms of their respective applications: plutonium recovery, and waste volume reduction of uranium oxide contaminated materials. Basic research on institutional type incinerators is reviewed. (auth)

29240 (TID-7627(p.461-74)) REMOVAL OF HYDROGEN, CARBON MONOXIDE, AND METHANE FROM GAS COOLED REACTOR HELIUM COOLANTS. C. D. Scott (Oak Ridge National Lab., Tenn.).

It is necessary to maintain low contamination levels in gas-cooled reactor helium coolants and in-pile loops. The anticipated major non-radioactive, gaseous contaminents are H_2O, CO_2, H_2, CO, and CH_4. A two-step purification system for removal of these contaminants is proposed in which first all oxidizable gases are oxidized to H_2O and CO_2 and then the H_2O and CO_2 are removed from the helium by fixed bed co-sorption. Although catalytic oxidation of the H_2, CO, and CH_4 by oxygen is possible, control problems make this method unacceptable when low contamination levels are desired. The alternate method of oxidation at low contamination levels is by fixed-beds of pelleted CuO. Kinetic tests on the reaction of H_2, CO, and CH_4 from a flowing stream of helium with fixed beds of CuO were made in the temperature range of 400 to 600°C, pressure of 10 to 30 atm and mass flow rates of 0.085 to 0.255 g-moles/cm^2-min at contamination levels of 900 to 12,000 ppm by vol. It was shown that the controlling reaction rate mechanisms for the reactions of H_2 and CO with CuO are mass transfer of the H_2 or CO from the bulk gas to the reaction site within the pellet while the CH_4–CuO reaction is dependent on CH_4 concentration in the bulk gas and available CuO surface area. Finite difference type computer codes based on the determined reaction mechanisms were written and demonstrated which will describe the fixed-bed effluent concentration of H_2, CO, and CH_4 as a function of time, for any size bed in the range of experimental conditions tested. Initial experimental results from kinetic tests on the co-sorption of H_2O and CO_2 by Molecular Sieves indicated that this process is feasible and the H_2O is sorbed preferentially to the CO_2. (auth)

29241 (TID-7627(p.475-93)) METEOROLOGY AND AIR CLEANING. Donald H. Pack (Weather Bureau, Washington, D. C.).

Brief descriptions are given of several new meteorological techniques for measuring atmospheric transport and dilution that were developed in the past five years. Among these are the use of atmospheric tracer techniques, direct application of wind measurements to diffusion, and the determination of trajectories over distances in the excess of ten miles. (auth)

29242 (TID-7627(p.494-506)) COMBINED DEPOSITION AND DIFFUSION STUDIES. Maynard E. Smith (Brookhaven National Lab., Upton, N. Y.).

A series of combined diffusion-deposition field studies are being made to provide detailed information on the behavior of small particles in the atmosphere, and to permit evaluation of this behavior in terms of meteorological parameters. A dual particulate emission consisting of uranine dye and radioactive copper particles is used in conjunction with a variety of sampling techniques. The background of the studies, the equipment and procedures, and the nature of the resulting data are described. Plans for the forthcoming analysis are reviewed. (auth)

29243 (TID-7627(p.507-22)) ANALOGUE DEVICES FOR DISPERSION ESTIMATES. Walter M. Culkowski (Weather Bureau, Oak Ridge, Tenn.).

The introduction, in 1959, of an electronic circuit to measure, directly, the standard deviation of meteorological parameters provided the needed impetus for devising rapid and low cost methods of estimating atmospheric dispersion conditions. The Jones and Pasquill circuit, a few of its variations, its present use and possible future applications are described. In addition, a few examples of other analog techniques are presented. (auth)

29244 (TID-7627(p.523-30)) THE CONTAINMENT OF FISSION PRODUCTS IN A POWER REACTOR. J. A. Riley (United Kingdom Atomic Energy Authority. [Reactor Group], Risley, Lancs, England).

Methods of removing iodine and other radioisotopes from gas streams in oxide-fueled gas-cooled reactors are discussed. The types of gas discharge that can occur under normal and emergency conditions were considered. Gas treatment processes are outlined. To illustrate the application of gas treatment methods to a power reactor, the case of a 1000 Mw(t) reactor using UO_2 fuel canned in stainless steel was considered. (M.C.G.)

29245 (TID-7627(p.531-48)) AIR CLEANING IMPLICATIONS IN FALLOUT STUDIES. George T. Anton (Atomic Energy Commission, Washington, D. C.).

The relationships between air cleaning and air sampling research connected with fallout studies are indicated. Efforts of more specific interest to the air cleaning community are pointed out. Capability of the AEC, Health and Safety Laboratory, at its new facility for advanced aerosol technology is explained. Radioactive particle sizes from early fallout at the Pacific and Nevada nuclear tests and the stratospheric dribble of fallout from the world-wide reservoir of radioactivity injected above the troposphere are discussed. (auth)

29246 (TID-7627(p.549-56)) PERFORMANCE OF HIGH EFFICIENCY PARTICULATE FILTERS SUBJECTED TO STEAM-AIR MIXTURES. J. B. Hays (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

Five high efficiency particulate air filters from two different manufacturers were exposed to steam-air mixtures with entrained liquid moisture for periods of 10 days. Four of the filters survived the test without obvious failure and had final DOP penetrations of less than 1% at the conclusion of the 10-day exposure. One filter, however, was severely damaged as a result of this exposure. (auth)

29247 (TID-7627(p.557-80)) WASTE PROCESSING OFF-GAS SCRUBBER STUDIES. Y. Takashima, W. T. Kyritsis, R. Dennis, and L. Silverman (Harvard Univ., Boston. School of Public Health).

Volume reduction of highly radioactive aqueous alumi-

num nitrate waste by evaporation and calcination to stable solid aluminum oxide in pot calciners can produce gas-borne particulates. A simple containment scrubber concept is introduced utilizing a commercial liquid-jet fume scrubber at the inlet of a closed vessel for condensation of vapor and removal of particulates by continued water droplet impingement. Results are presented for the jet-scrubber unit on open cycle (once-through) removal of fly ash and iron oxide aerosols, nitric acid, gas and mist, iodine vapor, and oxides of nitrogen and sulfur gases. Preliminary results are also given for the closed system pot calciner-water jet containment scrubber concept during reduction of simulated aluminum nitrate waste solution to calcined aluminum oxide. (auth)

29248 (TID-7627(p.581-97)) AIR MONITORING FOLLOWING THE SL-1 ACCIDENT. George Wehmann (Idaho Operations Office. Health and Safety Div., AEC).

The air monitoring program following the SL-1 accident is described. The types of sampling equipment and media utilized are discussed. Air concentration data and resultant doses due to I^{131} are presented. (auth)

29249 (TID-16466) THE STUDY OF THE BEHAVIOR AND SIGNIFICANCE OF CERTAIN RADIOACTIVE ISOTOPES FOUND IN THE SEWAGE TREATMENT PLANTS OF SELECTED CITIES. PART A. COMPARISON OF THE HYPERION PLANT OF THE CITY OF LOS ANGELES WITH ELEVEN OTHER TREATMENT PLANTS. Summary for 1960-1961. T. R. Folsom (Scripps Institution of Oceanography, La Jolla, Calif.) and G. J. Mohanrao (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Dec. 8, 1961. Contract AT(11-1)-34. 85p.

This report describes measurements of traces of certain radioactivities made between 1958 and 1961 at the Hyperion Treatment Plant of the City of Los Angeles and in samples from 11 other selected sewage treatment plants. Only gamma ray emitters were studied, and most attention was given to the behavior of cesium-137, one of the long-lived fission products. However, other isotopes measured in sewage include cobalt-60, zinc-65, iodine-131, radium-226, thorium-232, and potassium-40. Special methods have been developed for conveniently determining the low levels of radiocesium now found in tap water and in sea water, and the cesium-137 activity found in Hyperion sewage has been compared with that now present in the coastal waters and in the waters of the open Pacific. No concentration believed hazardous has been discovered in any of the treatment plants, but the effects of the new usage of artificial radioactivities are already discernible above the natural background radioactivities in many sewage specimens, as was the reappearance of young fallout activities only a few weeks after weapons testing was renewed. (auth)

29250 (WT-1449) RESPONSE OF DUAL-PURPOSE REINFORCED-CONCRETE MASS SHELTER. E. Cohen, E. Laing, and A. Bottenhofer (Ammann and Whitney, New York). Apr. 1961. Project 30.2 of OPERATION PLUMBBOB. 134p.

A reinforced-concrete dual-purpose underground parking garage and personnel shelter designed for a long-duration incident pressure of 40 psi was tested. The shelter was exposed to shot Priscilla, an approximately 37-kt 700-ft balloon burst (June 24, 1957), at a ground range of 1600 ft (predicted 35-psi peak incident-pressure level). The recorded peak incident pressure at the shelter was approximately 39 psi. Postshot soil borings were made to obtain undisturbed samples for determining soil characteristics. Preshot and postshot field surveys were made to determine the total lateral and vertical displacement of the structure. The test structure provided adequate protection from the effects of the test device at the test GZ distance. Despite failure of the door sealing gasket, a rise in pressure in the interior did not exceed 1.0 psi. The flat-slab roof and supporting structure were more than adequate to resist the 39-psi peak incident test loading. (P.C.H.)

29251 (FTD-TT-62-668) REPORT OF THE SECOND COMMITTEE ON THE PERMISSIBLE DOSAGE FOR INTERNAL RADIATION. Translated from Kernenergie, 4: Nos. 10-11, Suppl., 117B-79B(1961). 71p.

Data concerning factors associated with permissible internal radiation dosages are presented. Included are data on elements in the organs of a standard human, mass and effective radius of average adult male organs, and biological and physical constants used. Also included are tables of data on average-person assimilation and elimination, respiratory tract particles, and stomach-intestine operation parameters. (J.R.D.)

29252 (JPRS-14621) BASIC COMPULSORY SANITARY-PROPHYLACTIC STANDARDS NECESSARY FOR THE APPRAISAL OF ENVIRONMENT DURING THE WORK OF ACCELERATORS. L. V. Kuznetsova. Translated from p.62-7 of "Gigiena Truda pri Rabote na Nekotorykh Vidakh Uskoritel'nykh Ustanovok" Moscow, 1960. 10p.

Standards concerning maximum allowable radiation dosage in the USSR are presented. These values are primarily associated with accelerator environments. Other information is included on noise loudness and ozone concentration. (J.R.D.)

29253 (UCRL-Trans-839(L)) RAY-PROTECTION SUIT FOR FIREMEN. Max Schenk. Translated by Sergey Shewchuck and William Distler (California. Univ., Berkeley. Lawrence Radiation Lab.) from VFDB (Ver. Förder. Deut. Brandschutzes) Z., 11: 5-9(June 1962). 15p.

Problems in the design of protective clothing for firemen at atomic energy plants are discussed. The possible hazards that would be encountered and the protection afforded by protective clothing are discussed. It is concluded that the major hazard for firemen is that of contamination or inhalation of radioactive particles. A protective suit is described, for use in conjunction with respiratory equipment, that is considered adequate for most fire department applications. (C.H.)

29254 SOME EXPERIENCE WITH RADIOIODINE IN THE REACTOR BUILDINGS AT CHALK RIVER. C. G. Seymour (Atomic Energy of Canada, Chalk River, Ont.). Am. Ind. Hyg. Assoc. J., 23: 240-4(May-June 1962).

Practical experience with radioiodine in the heavy water reactors at Chalk River is described. Airborne and surface contamination caused by the release of radioiodine from ruptured fuel in the reactor and defective fuel samples in the high pressure, high temperature experimental loops are discussed. Monitoring techniques, skin contamination, and uptake of radioiodine by operating personnel are described briefly. (auth)

29255 METHODS FOR PERFORMANCE TESTING OF RESPIRATORY PROTECTIVE EQUIPMENT. F. E. Adley and D. E. Wisehart (General Electric Co., Richland, Wash.). Am. Ind. Hyg. Assoc. J., 23: 251-6(July-Aug. 1962). (HW-SA-2557)

A program is described for the evaluation of performance characteristics of respiratory protective devices which may be used normally for radiological protection. Leakage in the equipment or the fit of the facepieces may be pinpointed by these tests. Limitations of the field of vision

and the effects of cold are measured. The greatest problem of leakage in devices tested was the fit of the nose-cup. Some masks limited the field of vision sufficiently to create potential hazards. Inhalation and exhalation valves operated satisfactorily at temperatures as low as 0°F. Anti-fog chemicals will prevent fogging of lenses, but will not prevent frosting. (auth)

29256 BASIC PROBLEMS OF RADIATION HYGIENE. H. Lagendorff (Universitat, Freiburg i. B.). Arch. Hyg. Bakteriol., 146: 81-92(1962).

Various natural and artificial sources of radiation in the environment are discussed, particularly from the point of view of estimated yearly doses from external and internal sources, geographic and geologic variations, fall-out products, and contamination of ground water and food supplies. Several examples are cited of accidental contamination at nuclear power reactor sites and of the measures taken to protect the local population. The role of public health workers in protection against such accidents is discussed. (H.H.D.)

29257 TRANSPORT OF RADIOISOTOPES. U. Engelbert (Isotopes Division, Australian A. E. C.). Atomic Energy 5, No. 3: 11-15(July 1962).

Safety regulations and types of containers are outlined for the transport of alpha-, beta-, gamma-, and neutron-emitting substances. (T.F.H.)

29258 DOSIMETRY OF SOFT X RAYS AND BIOLOGICAL EXPERIMENTATION. J. L. Garsou (Hôpital de Bavière, Liege). Compt. rend. soc. biol., 156: 388-90(1962). (In French)

A study was made to determine what part of the spectra of x rays was preferentially absorbed by water 2.5 mm thick. The results show that 49% of the intensities put out by an Emachlett tube operating at 50 kv is absorbed by the water shield; 67% of this absorbed energy is furnished by photons with energy from 4.6 to 11.7 kev. The readings of the Phillips dosimetry provided with the ionization chamber should be theoretically given a coefficient of 1.018 when the measurement is made directly on the tube radiation; the correction is therefore negligible. The correction is zero if the measurement is related to the radiation transmitted by 2.5 mm of water. (J.S.R.)

29259 HEMATOLOGICAL PROBLEMS IN LABORATORIES AT NUCLEAR CENTERS. E. Bazzano (Laboratori CISE, Segrate, Milan and CESNEF, Milan) and E. Ghislandi. Energia nucleare (Milan), 9: 349-54(June 1962). (In Italian)

Some hematological problems in the field of medical supervision for radiation workers are discussed. Particularly, the frequency of primary leucopenia, the percent value of basophil granulocytes in the differential leucocyte count, and the occurrence of binucleate lymphocytes are described. (auth)

29260 RADIATION MEASUREMENTS IN MEDICAL RADIOLOGY. H. R. Schinz and R. Wideroee (Radiotherapeutische Klinik des Kantonsspitals, Zurich). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 97: 63-81(July 1962). (In German)

In medical radiology one is, in the first place, concerned with measurements across the fields of irradiation, particularly in free air. These measurements constitute what the authors call radiometry, the practical unit of the flux density being the roentgen (r). The main method used is the measurement of ionization whereby electron equilibrium must be obtained. The next step is the investigation of those doses which are produced by the absorption of radiation energy in solids and liquids. This procedure is called dosimetry. Here the unit of dose is the rad. The main method of measurement is based again on the measurement of ionization whereby the Bragg-Gray condition must be fulfilled. As auxiliary unit for such dosimetric measurements the authors use the rho (ρ). Radiometry is of interest first of all to the radiation physicist, while the physician deals chiefly with dosimetry. The ionization measurement methods of the two disciplines are explained, and as examples of the areas of radiation protection against gamma- and beta-emitting isotopes as well as radioactive contamination, the uses of these ideas in radiobiology are shown. (auth)

29261 PERMISSIBLE CONCENTRATIONS OF RADIONUCLIDES IN SEA WATER. A. H. W. Aten, Jr. (Inst. for Nuclear Physics Research, Amsterdam). Health Phys., 6: 114-25(1961). (In English)

Methods are discussed for the calculation of the maximum permissible concentration of various radionuclides in sea water. The values are based on the maximum permissible concentrations in drinking water as fixed by the I.C.R.P. Concentration factors of radionuclides in fish are discussed and the protection of fish against the uptake of radioactive nuclides by inactive isotopes and by elements in the sea water which are chemically related to the radioisotopes is taken into account. In the Appendix the application of the maximum permissible concentrations in sea water is discussed for the simplified case of waste disposal into the sea. (auth)

29262 SURFACE CONTAMINATION MEASUREMENTS AS AN INDEX OF CONTROL OF RADIOACTIVE MATERIALS. H. J. Dunster (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Health Phys., 8: 353-6 (Aug. 1962).

The purpose and objections to surface contamination measurements are reviewed. The need for permissible values in this field is evident and the general basis of the derivation of the values in use in the United Kingdom is discussed. Surface contamination can provide an indicator of the degree of control which is being maintained over operations with radioactive materials and, in most cases, is a reliable indication of whether air monitoring is required. (auth)

29263 THE POSTATTACK WATER-CONTAMINATION PROBLEM. William J. Lacy and Marlow J. Stangler (Office of Civil Defense, Washington, D. C.). Health Phys., 8: 423-7(Aug. 1962).

Contaminating conditions, fallout levels, internal-dose criteria, the early radioiodine ingestion problem, and the effectiveness of various water decontamination processes are discussed. Dose calculations indicate that the problem of a fallout-contaminated water supply will not be severe in most cases. Radioiodine concentration by the thyroid and the resultant exposure is more serious the first 100 days after attack than the dose to the bone. However, the radiation exposures are such that they and the water supply hazard cannot be ignored. The effectiveness of various water decontamination processes is discussed. (auth)

29264 RADIOACTIVE CONTAMINATION OF FOOD. L. R. Setter (Robert A. Taft Sanitary Engineering Center, Cincinnati). J. Am. Dietetic Assoc., 38: 561-6(Dec. 1962).

The environment and, consequently, food contains measurable amounts of radionuclides arising primarily from the distribution of nuclear bomb debris over the entire earth's surface. This radioactivity is in addition to natural radioactivity which exists in the environment. A wealth of information has been gathered on the artificial radioactivity in air, water, vegetation, and soil; on physical and chemical mechanisms of radioactive movement in the biosphere; and

on the biologic behavior of radionuclide uptake by animals and human beings and their distribution in excretions and secretions. Collection of additional information under more carefully designed and executed studies is under way. There remains the task of marshalling and reviewing the data obtained during active fall-out up to the summer of 1959. With later information collected during a period of substantially no fall-out, the interpretation of these data hopefully will indicate the relative magnitude of physical, chemical, and biologic factors influencing levels in plants and animals, provide a means of predicting future levels, and, most important, permit some evaluation of the effects of nuclear radiation from ingestion of contaminated food as a part of the total effects from fall-out and from natural radioactivity. (auth)

29265 TECHNICAL AND MEDICAL ASPECTS OF NUCLEAR-POWERED AIRPLANES: THE ROLE OF NUCLEAR POWER IN THE ATMOSPHERE AND IN SPACE. H. von Ubisch. Medd. Flyg- Navalmed. Namnden, 10: No. 2, 9-15(1961). (In Swedish)

An evaluation is given of the merits of potential nuclear propulsion systems for aircraft and rockets as well as of small nuclear power plants for auxiliary use in space exploration. The protection of personnel and passengers against gamma and high-velocity radiation is discussed, and the shielding properties of various materials are analysed. Mobile shielding would be required for airplanes even when landed and the reactor is shut down. No significant pollution of the atmosphere is expected from leaking reactors, but accidents constitute a real danger. The prospects of realizing the ion motor and the photon motor are speculated upon. (auth)

29266 ACTIVE SURFACE OF ULTRAMICROSCOPIC ATMOSPHERIC DUSTS AND THEIR RATIO WITH THE USE OF FILTERS FOR ATMOSPHERIC RADIOACTIVITY. Giovanni Giulio Calapaj (Università, Padua). Minerva nucleare, 6: 97-101(Apr. 1962). (In Italian)

A method for size frequency analysis of samples of atmospheric dust including microscopic and ultramicroscopic particles is briefly described. The results obtained on samples of atmospheric dust collected in Padua at various times are reported Two frequency peaks, one at about 50 mμ and the other at about 0.7 μ, were found; both tend to disappear in the spring. A comparison of the surface of the particles with their diameter and their uptake in the alveolar space of the lung reveals that the biological effect of ultramicroscopic particles is far greater than that of the microscopic ones. Similar results, even though less conspicuous, are arrived at by assessing the ratio between the number of particles retained in SS 589/1 filters for atmospheric radioactivity and those which escape. (auth)

29267 DOSE DISTRIBUTION OF 15-Mev ELECTRONS IN GRID IRRADIATION. C. Bompiani and A. V. del Vescovo (Università, Rome). Minerva nucleare, 6: 122-8 (Apr. 1962). (In Italian)

The results of an investigation of the pattern of distribution of the dose of radiations below a grid exposed to beams of high-energy electrons are reported. The influence of the size of the beam of radiations and of the holes and aperture of the grid on the distribution of the dose is discussed. (auth)

29268 DETERMINATION OF AIRBORNE FISSION PRODUCT RADIOACTIVITY USING GAMMA-RAY SPECTROMETRY. P. F. Gustafson, S. S. Brar, and U. C. Mishra (Argonne National Lab., Ill.). Nature, 195: 557-9 (Aug. 11, 1962).

A method for the rapid determination of the radon and thoron daughter content of an air filter shortly after removal from the pump is described. It utilizes γ-ray measurements in a portion of the energy spectrum in which the spectral shape does not change with time. Afterwards, the contribution to the net counting-rate over a wider energy region from radon and thoron daughter products is removed. In addition to determining the concentration of gross γ activity due to fission products in terms of $\mu\mu c/m^3$ of air, the concentration of La^{140} and Ba^{140} was also measured. Beta and gamma measurements were made on the same portion of 50 daily air filters several days after collection. The gross β count-rates were expressed in $\mu\mu c/m^3$ of air using a Tl^{204} source of known activity. The ratio of β/γ activity was found to be 1.9 ± 0.15. By using the β/γ ratio it was possible to compare the gross γ results with measurements made at other sites where air-borne radioactivity is expressed in terms of gross β activity. (P.C.H.)

29269 MAXIMUM PERMISSIBLE DOSE OF IONIZING RADIATION. Tadeusz Musiałowicz. Polski Przealad Radiol. i Med. Nuklearmej, 26: 241-9(1962). (In Polish)

A table of sources of natural radioactivity and their daily dosage contributions is given and compared with USAEC 1950 listing of probable damaging effects for a single exposure (within one day) to various levels of radiation dosage. The importance of time span for a given dose is discussed. The historical variation of maximum permissible dose (MPD) is covered from 1925 to the present. This includes values of the weekly MPD recommended by authoritative groups throughout the world, and compares the values of MPD in Poland with other accepted values. Finally, the 1959 report of the International Commission on Radiological Protection is reviewed in detail. Such items as the accumulated MPD versus age of the person, the MPD for various organs of the body, genetic dosage, and the basis for establishing MPD levels are covered. (TTT)

29270 A RATIONAL SYSTEM OF DESIGNING A DEPARTMENT AND PROTECTION DURING WORK WITH CLOSED RADIOACTIVE PREPARATIONS. I. G. Lagunova, A. V. Kozlova, A. K. Pervova, A. F. Rimman, V. V. Dmokhovsky, and I. M. Parshin. Med. Radiol., 7, No. 6: 69-76 (June 1962). (In Russian)

Protection during work with closed radioactive preparations may be quite effective if the designing of a radiological department and protective equipment take into account the features peculiar to the technological process of radium therapy. Intermediate operations have been shown to be the cause of excessive irradiation of the personnel. The new protective equipment made necessary the introduction of alterations in the existing technological process. (auth)

29271 ENVIRONMENTAL MONITORING AT NUCLEAR FACILITIES. M. I. Goldman, C. R. McCullough, and W. F. Witzig (Nuclear Utility Services, Inc., Washington, D. C.). Preprint Paper No. 73. New York, Engineers Joint Council, 1962. 15p.

The backgound and status of environmental radiological monitoring programs for nuclear facilities are reviewed. The thesis is developed that such programs in the past have not been responsible to the operational dictates of the plants. A basis for logical development of required environmental programs is suggested. The conclusion is reached that the comprehensive program is better suited to the health agency role and the expense to a facility operator of maintaining such a program may be better used for in-plant processing of wastes before release. (auth)

29272 STUDIES ON THE DISTRIBUTION OF RADIONUCLIDES IN THE CLINCH AND TENNESSEE RIVERS BELOW OAK RIDGE. Albert G. Friend and Donald B. Porcella (Public Health Service, Washington, D. C.). Preprint Paper No. 75. New York, Engineers Joint Council, 1962. 24p.

The distributions and concentrations of radionuclides in the aquatic environment of the Clinch and Tennessee Rivers below Oak Ridge are discussed. (L.T.W.)

29273 SHIPPING AND STORING POWER FUELS PRIOR TO REPROCESSING. S. D. Smiley, J. W. Langhaar, and R. Maher (E. I. du Pont de Nemours and Co., Aiken, S. C.). Preprint Paper No. 82. New York, Engineers Joint Council, 1962. 22p.

Conditions and regulations governing the storage and processing of spent fuels and blanket materials from nuclear reactors are discussed. Basic requirements of casks for shipping irradiated fuels are reviewed from the standpoint of hazard to the public. Facilities are now under construction at the Savannah River Plant for the receipt and storage of certain assigned fuels. Technical considerations pertaining to the design of these facilities are discussed. The physical plant, the services offered, and the operation of the plant are described. (auth)

29274 GEOLOGIC ENVIRONMENT OF AN OXIDIZED URANIUM DEPOSIT IN THE BLACK HILLS SOUTH DAKOTA. N. P. Cuppels (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1063-C. 1962. 26p. (GPO).

One of the largest oxidized deposits of uranium in the Black Hills is at the Gould mine in Fall River County, S. Dak. The mine is on the dip slope of the Lower Cretaceous Inyan Kara group of fluviatile sedimentary rocks that form a hogback peripheral to the Black Hills. The deposit consists of a concentration of hydrated uranium vanadates distributed irregularly through a zone 1 to 15 feet thick near the middle of a thick sandstone unit of the Lakota formation. The eastward-trending zone is 800 feet long and 130 feet wide. The top boundary of the zone is roughly parallel with, and several feet below, an unconformity at the base of a silt-gall conglomerate. Geochemical data suggest that the deposit is a product of the oxidation and local redistribution of an ancestral low-valent ore body. Comingling of solutions beneath the conglomerate may have been the primary control in localizing the ore. The distribution of uranium within the ore zone was controlled by fractures and differential permeability within the host rocks. (auth)

29275 URANIUM OCCURRENCES IN SEDIMENTARY ROCKS OF PENNSYLVANIA. Harry Klemic (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1107-D. 1962. 49p. (GPO).

In Pennsylvania, uranium deposits occur in sedimentary rocks of Late Devonian to Late Triassic age in the Appalachian Plateaus, Ridge and Valley, and Piedmont provinces. As a result of searches made by prospectors and reconnaissance work by U. S. Geological Survey field parties, uranium occurrences were discovered in three principal stratigraphic sequences: Upper Devonian rocks, Upper Mississippian and Lower Pennsylvanian rocks, and Upper Triassic rocks. The uranium occurrences in Upper Devonian rocks are commonly associated with gray sandstone or shale that contains copper minerals and carbonaceous plant fossils, but this association is not marked in the largest deposits with the greatest concentration of uranium. The occurrences in the Upper Mississippian and Lower Pennsylvanian beds are in rocks that commonly contain carbonaceous material but do not have megascopically noticeable copper minerals. Those in the Triassic rocks contain small amounts of carbonaceous material, traces of copper, and some pyrite. Uraninite and possibly another black form of uranium oxide probably are primary minerals. Secondary uranium vanadates, phosphates, carbonates, silicates, and possibly arsenates are found in the various deposits. Spectrographic and chemical analyses show that the abundance of uranium is independent of the abundance of any other element. The only relation noted is that lead, vanadium, and selenium are most abundant in rocks in which uranium is also abundant. Some of the uranium occurrences probably formed by syngenetic deposition, others by early epigenetic concentration, and a few by relatively recent leaching and redeposition by ground water. Of the many known uranium occurrences only two, both in Carbon County, seem to be deposits of potential economic value. (auth)

29276 URANIUM AND OTHER TRACE ELEMENTS IN DEVONIAN AND MISSISSIPPIAN BLACK SHALES IN THE CENTRAL MIDCONTINENT AREA. E. R. Lands (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1107-E. 1962. 51p. (GPO).

The Woodford shale was examined at 10 localities in Oklahoma. Uranium content of the samples ranges from less than 0.001 to 0.014%, but the modal, median, and arithmetic mean values of the Woodford samples as a whole and the samples of the shale only are 0.001, 0.002, and 0.003% uranium, respectively. These values are probably representative of most of the Woodford except the phosphatic nodules that are present in some parts of the formation. The samples of phosphatic nodules and laminae have an average uranium content of 0.006%. The Chattanooga shale was examined and sampled at 7 outcrop localities in Oklahoma, 10 in Arkansas, and 1 in Missouri, and samples of cores from 2 drill holes in Kansas were also collected. A total of 95 samples, of which 83 were shale samples, was collected, and the uranium content ranged from less than 0.001 to 0.55%. Only one sample contained more than 0.013% uranium; that was a selected sample of highly radioactive organic-rich material. No samples of shale contained more than 0.012% uranium, and the modal and median values of the Chattanooga samples as a whole are 0.002% uranium. The Arkansas novaculite was sampled at 15 localities in Arkansas and Oklahoma. Only one sample contained more than 0.004% uranium, and it was from a locality in Garland County, Ark., where the Arkansas novaculite was contact metamorphosed. The average uranium value of all samples from the formation is 0.001%; this is believed to be representative of the uranium content of the formation in the report area. Despite the low uranium contents of these formations as a whole, at one locality the Chattanooga shale contains as much as 0.005% uranium in an interval 10.1 feet thick, and the Woodford contains as much as 0.005% uranium in intervals up to 20 feet thick. In general, if rock of this grade ever becomes of economic interest, the small amount of overburden on the black shale of the Woodford would make it more amenable to large-scale surface-mining methods than the Chattanooga. Selected shale samples were analyzed for organic-carbon content and oil yield. A positive relation of organic-carbon content to uranium content is suggested. A few samples contained enough oil for specific-gravity determination. The number of samples is not sufficient to allow evaluation of the relation, but in these samples the larger the uranium content, the higher the specific gravity of the oil. (auth)

29277 GEOLOGY OF URANIUM IN COALY CARBONACEOUS ROCKS. James D. Vine (Geological Survey, Wash-

ington, D. C.). Geological Survey Professional Paper 356-D. 1962. 61p. (GPO).

Though the association of uranium with coaly rock near Denver, Colo., was first reported in 1875, very little was known about the relation of uranium to coaly rocks until the decade 1946 to 56. Coaly carbonaceous rocks characteristically contain nonmarine indigenous humic plant remains that accumulate in swamps. An arbitrary classification by percent ash is used to distinguish coal, impure coal, coaly shale, and carbonaceous shale. Uranium is only one of many inorganic constituents of these rocks. The average abundance of uranium in coaly carbonaceous rocks may normally be less than 0.0001%. Coaly carbonaceous rocks that contain at least 0.005% uranium are classed as uranium deposits. The known such deposits in the United States occur in five general rock types: unconsolidated peaty material, lignite and subbituminous coal, bituminous and anthracitic coal, impure lignite and lignitic shale, and carbonaceous shale. The uranium in alpine-meadow peaty soils is evidently introduced continuously by spring waters and becomes concentrated in the living plants and especially in the decaying plant debris that accumulates in the meadow soil. Lignite and subbituminous coal in the Rocky Mountain and Great Plains regions contains a number of large deposits of uranium, but the tenor for large tonnages rarely exceeds 0.015%. Bituminous and anthracitic coal in the United States is not known to contain more than a few small, low-grade deposits of uranium. At least 14 areas of impure lignite and lignitic shale in the United States contain economically significant deposits of uranium. Carbonaceous-shale beds in several areas contain uranium deposits. Some types of coaly carbonaceous rocks are far more favorable host rocks for uranium than others. Unconsolidated peaty material is capable of being greatly enriched in uranium, but only rarely are deposits found in peat. Lignite and subbituminous coal have the capacity to take up abundant uranium, but the physical properties of these rocks are apparently less favorable for concentrating uranium than are those of impure lignite and of lignitic shale. Bituminous and anthracitic coals are generally unfavorable host rocks for uranium. Carbonaceous shale seems to be a chemically favorable but a physically unfavorable host rock. The regional geology and tectonic setting can be related only vaguely to the distribution of uranium deposits. A regional unconformity may predispose an area as large as the Fort Union lignite region as a favorable setting, yet also by truncation of any single bed may cause selective enrichment of uranium in favorable host rocks. Uranium is concentrated locally in or adjacent to permeable formations and beds and in permeable zones within the host rock. There is no evidence, other than the presence of the uranium deposits, that a uranium-rich province exists in the Fort Union lignite region. Many types of ground water may transport uranium. Other types of uranium deposits may be associated with those in coaly carbonaceous rocks. Because host-rock lithology is the basis for distinguishing uranium deposits in coaly carbonaceous rocks, genetically diverse types are included, each of which is associated with a different type of related deposit. Some uranium deposits in sandstone may consist of redeposited and hardened uraniferous humic acids that were extracted from coaly carbonaceous matter. The physical and chemical form of uranium in coaly carbonaceous rocks is obscure because uranium minerals are rarely visible and never account for all the metal present. The amount of inherent uranium in these rocks is generally insignificant. Even where plants grow in a uraniferous environment the sorption of uranium on decaying plant materials far exceeds the contribution from living organisms. The contribution of uranium from detrital minerals is also insignificant. Locally, an appreciable amount of uranium is in the form of epigenetic uranium minerals, but most of the uranium in deposits in coaly carbonaceous rocks is in the form of fixed adventitious uranium. A marked local variation in the abundance of uranium not clearly related to variable rock composition is characteristic of deposits in coaly carbonaceous rocks. Chemical tests show that, though three-fourths of the uranium in an unweathered coaly shale sample was in the sexivalent state, a large part of the uranium might occur as uraninite. The uranium in coaly carbonaceous rocks even in unweathered material is not volatile and is relatively insoluble in water and organic solvents but is readily soluble in strong acids or alkalis. Mild air oxidation of lignite may make possible the removal of some of the uranium by extraction of humic acids. The original sorption of uranium by peat, lignite, and humic acids apparently is an ion-exchange process that is effective even at the relatively low concentrations of uranium found in nature. Uranium is not lost during the early stages of the weathering of lignite. One study has shown a positive correlation between uranium and the concentration of calcium, magnesium, and iron, but there is reason to doubt the existence of a simple direct relation. The role of coaly carbonaceous rocks in the geochemistry of uranium is known only in general terms. Only those low-rank carbonaceous materials that have a chemical structure related to humic acids are commonly associated with uranium. Peat probably has the greatest capacity to take up uranium, but in the normal peat-bog environment uranium is rarely available. Because broad areas of coaly carbonaceous rocks are uniformly exposed to uranium-bearing waters in adjacent permeable units, epigenetic deposits are characteristically thinner and of lower grade than deposits in sandstone where mineral deposition can be localized. Epigenetic uranium in coaly carbonaceous rocks is probably directly related to the concentration of uranium available in solution, whereas the uranium contained in sandstone deposits is probably not related directly to the availability of uranium in solution as much as to the effectiveness of some mechanism for precipitation. The secondary uranium minerals found in weathered lignite may be deposited by evaporation of capillary pore moisture. Uranium is concentrated in the marine environment at the time of sediment accumulation, but the coaly carbonaceous rocks continue to concentrate uranium after burial of the sediment; thus, the role of uranium concentration in coaly carbonaceous rocks and marine black shale tends to the complementary. The geochemical enrichment of uranium in coaly carbonaceous rocks is the result of cation exchange on humic or coaly carbonaceous matter, a unique geologic process which uranium does not share with any of the major elements in a sedimentary environment. (auth)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

29278 (BMI-X-199) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report No. 12. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). Apr. 18, 1962. Includes Sections: I. USE OF INTRINSIC RADIOTRACERS FOR PROCESS CONTROL. James L. McFarling, Peter Gluck, John F. Kircher, et al. II. RADIATION-INDUCED GRAFT-POLYMERIZATION STUDIES. Francis A. Sliemers, Manfred Luttinger, Emir Gueibaran, et al. Contract W-7405-eng-92. 24p.

Continued research is reported in the areas of intrinsic radioactive tracers for industrial process control and the effects of structural factors on radioinduced graft polymerization. The use of Be–Po neutron sources for production of short-lived isotopes is being investigated. Data are included on the effects of target volume, high-Z scattering media, target-isotope concentration, and macroscopic cross-section on specific and total activation produced with a 10-curie source. Research on graft-polymerization concerning the effects of structure on free-radical site concentrations and graft efficiency was continued. Results indicate that the radical formed in a variety of substituted methacrylate polymers is the same in all cases. (J.R.D.)

29279 (BMI-X-10009) RADIOISOTOPE AND RADIATION APPLICATIONS. Quarterly Progress Report No. 13. Duane N. Sunderman, ed. (Battelle Memorial Inst., Columbus, Ohio). July 19, 1962. Includes Sections: I. USE OF INTRINSIC RADIOTRACERS FOR PROCESS CONTROL. Peter Gluck, John F. Kircher, Charles W. Townley, et al. II. RADIATION-INDUCED GRAFT-POLYMERIZATION STUDIES. Francis A. Sliemers, Manfred Luttinger, William B. Gager, et al. III. A STUDY OF THE EFFECT OF INTERNAL IRRADIATION ON CATALYST ACTIVITY. James L. McFarling, John F. Kircher, and Duane N. Sunderman. Contract W-7405-eng-92. 34p.

Research was continued during the report period on the use of isotope neutron sources for producing short-lived radioisotopes. Experiments with a newly constructed beta-counting cell are reported in which a 50-curie Be–Po neutron source was used. Study of the radiation chemistry of polymers was continued concerning the effects of polymer structure on free-radical formation. Free-radical formation in several additional polymers was studied. Preliminary work is also reported in an investigation of internal irradiation effects on the chemical activity of catalysts. (J.R.D.)

29280 (NYO-9576) A STUDY OF THE EFFECTS OF SUB-STERILIZATION DOSES OF RADIATION ON THE STORAGE LIFE EXTENSION OF SOFT-SHELLED CLAMS AND HADDOCK FILLETS. Quarterly Progress Report, May–July 1962. John T. R. Nickerson, Samuel A. Goldblith, and Edmund B. Masurovsky (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-3006. 35p.

Haddock fillets and shucked, soft-shelled clams were exposed to various irradiation and storage treatments. Data are tabulated on counts of microflora and olfactory and textural changes after exposure to various doses of radiation. (C.H.)

29281 (ORNL-3335) THE PREPARATION, PROPERTIES, AND USES OF AMERICIUM-241, ALPHA-, GAMMA-, AND NEUTRON SOURCES. J. E. Strain and G. W. Leddicotte (Oak Ridge National Lab., Tenn.). Sept. 6, 1962. Contract W-7405-eng-26. 68p.

A study was made of the preparation of alpha, gamma, and neutron sources using the long-lived radioisotope of americium, Am^{241}. Americium-241 is an artificially-produced radioelement which has a half-life of 462 ± 10 years and decays to Np^{237} by alpha emission followed by low-energy gamma emission. The high specific activity of americium-241 (7.0×10^9 d/m/mg) combined with its reasonably long half-life makes it ideally suited for the preparation of radioactive sources. The chemical and physical properties of Am^{241} and the physical manipulations involved in fabricating alpha, gamma, and neutron sources are generally described in this report. Uses for each type of source are discussed and data are presented to indicate the respective properties and usefulness of each source type. (auth)

29282 CANADA'S POTATO IRRADIATION PROGRAM. PART 1. Food Irradiation, 2: No. 3, A2-A5(Jan.-Feb. 1962).

A pilot plant mobile irradiator with a conveyor system was designed and put into operation in the fall of 1961 for the radiation processing of potatoes. Thirty potato growers and processors participated in a program to irradiate about 1,000,000 lb of potatoes. The irradiator can be moved by tractor or on a railroad flatcar. The design, development, and construction of the unit were estimated to cost approximately $125,000. (C.H.)

29283 FRUIT JUICE IRRADIATION. H. Gaisch and K. Kaindl. Food Irradiation, 2: No. 3, A8-A10(Jan.-Feb. 1962).

Grape juice was irradiated with doses of 1.5 to 2.0 Mrad, which caused a complete inactivation of all yeast present in the juice. No detrimental changes in quality were observed when the juice was irradiated in a frozen state. (C.H.)

29284 RADIATION PRESERVATION OF MEAT PRODUCT. PAST AND FUTURE RESEARCH AT THE DANISH MEAT RESEARCH INSTITUTE, ROSKILDE, DENMARK. E. Stenberg Knudsen and P. I. Hansen. Food Irradiation, 2: No. 3, A11-A12(Jan.-Feb. 1962).

Preliminary results are reported from an evaluation of the usefulness of irradiation in lengthening the storage life of bacon, luncheon meats, and ham. Bacon exposed to a dose of about 0.5 million rads γ radiation showed an inactivation of living bacteria but a definite off-flavor. Luncheon meats processed by a combination of heat treatment and radiation had less radiation-induced off-flavor than either bacon or ham. A combination of heat treatment to center temperatures of 149 to 158°F and radiation dose of 0.4 to 0.6 million rads γ radiation resulted in commercially sterile canned hams after incubation for 30 days at 86°F. Hams treated in this way had a good color and texture but odor and taste were inferior to normal cooked hams. (C.H.)

29285 USE OF BACILLUS MEGATERIUM SPORES FOR CHECKING STERILIZATION BY RADIATION.

S. Davydoff-Alibert and B. Broullet (Centre d'Études Nucléaires, Fontenay-aux-Roses, France). Food Irradiation, 2: No. 3, A13-A15(Jan.-Feb. 1962).

Spores of Bacillus megaterium are recommended as a biological check of the effectiveness of radiation sterilization and for evaluation of the dose received. The procedure is outlined and data are presented on the survival of the spores in relation to the γ radiation dose received. (C.H.)

29286 DEVELOPMENT OF LACTOBACILLUS IN AN IRRADIATED MEDIUM. P. Dupuy and G. Mocquot. Food Irradiation, 2: No. 3, A-17(Jan.-Feb. 1962).

Warm milk exposed to a radiation dose of under 400 Krad acted as a slight stimulant to the growth of Lactobacilli and higher radiation doses inhibited growth. The growth inhibition was not sufficient to ensure preservation of the milk. The effects of the different constituents of milk, irradiated separately and as a mixture, on the growth of Lactobacilli were measured. It was found that inhibition of growth resulted only when serum was irradiated. (C.H.)

29287 THE CONTINUOUS MEASUREMENT OF THE HEIGHT OF COAL BY USING RADIOISOTOPES. P. Hudec and P. Schiller. Izmeritel'naya Tekh., No. 5, 56-7(May 1961).

Electical power stations require unified equipment for the control of the filling of coal hoppers and radioisotopes are well suited for this purpose. An automatic compensation regulation system is described for moving coal. This system is operated by a motor coupled to a transducer which transmits information on the position of the source-detector system to a monitoring control device. An electromechanical system disconnects the motor at a predetermined max and min position so that an even and regular coal supply is assured. A γ radiation source of 3 mc of Co^{60} is used. This makes it possible to work with 75-cm dia which could be increased if necessary. The radiation intensity is measured by a halogen-filled Geiger counter. (OID)

29288 A DIRECT RADIOISOTOPE METHOD OF INVESTIGATING THE WEAR OF WIRE DRAWING DIES. PART I AND II. J. Kleszniewski. Wire Ind., 28: 991-3 (Oct. 1961); 1111-16(Nov. 1961).

The economics of wire drawing depends on the performance and life of the drawing dies. This is the case in high speed drawing machines where the application of proper lubricants is in first place among the means for improving the efficiency in cold drawing of metals. An understanding of the mechanism of die wear and the effect of lubricants is, therefore, essential for the attainment of optimum performances. To investigate the processes involved, radioisotopic methods were applied. Rod and low carbon steel and also two harder steel grades were tested. The 6% Co-sintered carbide drawing dies of 5.00, 3.50, and 2.00 mm dia were irradiated in a USSR reactor, and their specific activity was 100 mc. The lubricants employed were phosphate + grease, phosphate + soap powder, lime + grease, and lime + soap powder. The drawing speeds were 1.5, 2.0, and 2.5 m/sec. The drawn wire was sampled according to certain statistical methods and, from the radioactivity of the samples, conclusions were made concerning the wear of the dies under experimental conditions. (OID)

29289 NEEDS AND OPPORTUNITIES FOR TRAINING ENGINEERS IN THE USE OF RADIOISOTOPES. Ralph T. Overman (Oak Ridge Inst. of Nuclear Studies, Tenn.). Preprint Paper No. 60. New York, Engineers Joint Council, 1962. 9p.

The setting up of training courses for engineers in the use of radioisotopes is outlined. (L.T.W.)

29290 ISOTOPIC HEAT AND POWER. Charles E. Crompton (Martin Marietta Corp., Denver). Preprint Paper No. 84. New York, Engineers Joint Council, 1962. 29p.

The design and performance of isotopically fueled direct conversion (thermoelectric) generators now in use and being constructed are reviewed. The use of fission products such as Sr^{90} and Cs^{137} is discussed together with the transuranic elements Pu^{238} and Cm^{242}. The major parameters affecting design and efficiency such as isotopic power density, shielding, thermoelectric materials, and heat transfer are reviewed. The paper endeavors to treat both the capabilities of today's systems and the problems that must be solved in building tomorrow's improved devices. (auth)

29291 FOOD PRESERVATION BY NUCLEAR ENERGY. Ferdinand P. Mehrlich (QM Food and Container Inst., Chicago). Preprint Paper No. 85. New York, Engineers Joint Council, 1962. 13p.

Various irradiation sources to be used at the Quartermaster Radiation Laboratory for sterilization of food products are described. (L.T.W.)

29292 TRACERS IN SMOG CONTROL, WATER RESOURCES AND STREAM POLLUTION. Ralph L. Ely, Jr. (Research Triangle Inst., Durham, N. C.). Preprint Paper No. 87. New York, Engineers Joint Council, 1962. 13p.

The use of radioisotopic techniques in studies of smog control, water resources, and stream pollution is outlined. The application of nuclear techniques, rather than tracers alone, is discussed. (L.T.W.)

29293 NUCLEAR INSTRUMENTATION CONTROLS FOR INDUSTRY. Donald C. Brunton (Industrial Nucleonics Corp., Columbus, Ohio). Preprint Paper No. 88. New York, Engineers Joint Council, 1962. 12p.

A brief review is given of the basic principles of nuclear gages and the critical engineering parameters. The prime requirements for industrial use of such gages and the types of problems encountered are examined. A survey of the fields of application is included and an example of their economic justification. Finally, a glimpse of future developments is included together with the relationship of such gaging to data processing and computer controls. (auth)

ISOTOPE SEPARATION

29294 (K-1527) A GENERALIZATION OF THE MATCHED ABUNDANCE RATIO CASCADE FOR MULTICOMPONENT ISOTOPE SEPARATION. A. de la Garza (Oak Ridge Gaseous Diffusion Plant, Tenn.). July 20, 1962. Contract W-7405-eng-26. 25p.

Matched abundance ratio cascades were introduced to the subject of multicomponent isotope separation in cascades. These cascades are formed in such a manner that the abundance ratio of two key components is matched wherever two streams come together, i.e., at all stage links and feed points. For a three-component mixture, for example, there are three (independent) abundance ratios, and accordingly, there are only three matched abundance ratio cascades which may be formed to process the mixture. The matched abundance ratio cascades can be generalized by considering matched abundance ratio cascades whose key components are dummy components, and the separation characteristics of these cascades can be varied by the choice of the molecular weights of the two dummy components. A generalization of the original matched abundance ratio cascades is presented. In so doing, closed and explicit formulas are developed for the usual unknowns in the resolution of the productivity of a three-stream cascade. In this way the laborious computations necessary to balance out a cascade in all the components are practically eliminated. The optimization of cascade design permitted by the previously mentioned variation of the cascade separation characteristics is also discussed briefly for both an end-component and a middle-component separation. (auth)

29295 (NYO-8771) SEPARATION AND EXCHANGE OF ISOTOPES. Annual Progress Report, June 16, 1961 to July 15, 1962. E. U. Monse, Lois Nash Kauder, F. S. Klein, Marvin J. Stern, Paul R. Gross, Robert Greenberger, and W. Spindel (Rutgers Univ., Newark, N. J.). July 15, 1962. Contract AT(30-1)-2250. 110p.

Current work on exchange reactions involving the isotopes of nitrogen, carbon, and oxygen is described. The single stage fractionation factor for exchange between liquid N_2O_3 and NO was measured at various temperatures and pressures. Decreased temperature and increased pressure both tend to increase the isotope separation factor by altering the chemical composition in the exchanging phases toward the simplified system: N_2O_3 in liquid and NO in gas. At 7 atm pressure and room temperature, α was found to be 1.030. This compares favorably with the value of α of 1.031, which is found for the system at 1 atm pressure, only at $-10°C$. The results confirm the possibility of operating the exchange system at elevated pressure, without refrigeration, for concentrating nitrogen isotopes. The effective separation factor was also fairly satisfactorily correlated with spectroscopically derived partition function ratios for the various chemical species in the system. Fractionation factors for oxygen exchange between azeotropic acid solutions and their vapors were compared and correlated with available spectroscopic data for oxonium ions. The agreement is reasonable at temperatures from 4 to 126°C. Calculation of partition function ratios for C and O isotope exchange between nickel carbonyl and CO were completed, and the calculations verified by experimental measurements of the effective single stage separation factors. (auth)

29296 (ORNL-1269) ELECTROMAGNETIC RESEARCH DIVISION QUARTERLY PROGRESS REPORT, PART I FOR PERIOD ENDING DECEMBER 31, 1951. F. T. Howard (Oak Ridge National Lab., Y-12 Area, Tenn.). May 19, 1952. Contract W-7405-eng-26). 47p.

Operation of the 86-in. cyclotron was continuous except for a three-day interruption caused by a water leak inside the vacuum chamber; monthly output averaged over 210,000 μa-hr; the average continuous (168-hour week) beam power was approximately 5.5 kw; and the energy of the beam was determined to be ~19.4 Mev. No changes because of radiation damage were detected in Inconel tubes containing $UF_4-NaF-KF$ eutectic which were irradiated in the 86-in. cyclotron with power inputs up to ~415 w/cc. The major components of the 63-in. cyclotron were fabricated and tested as the machine was being assembled. On the 22-in. cyclotron a radius-wise examination of the fine structure of the proton beam revealed definite proton orbits. Several grams of very pure U^{235} were prepared; the chemical recovery for first-stage separation of U^{234} was established as 97%; and facilities for laboratory-scale separation of Pu isotopes were being prepared. (auth)

29297 (Y-676) ELECTROMAGNETIC RESEARCH DIVISION PROGRESS REPORT JULY 1, 1950 TO OCTOBER 1, 1950. (Oak Ridge National Lab., Y-12 Area, Tenn.). Oct. 12, 1950. Contract W-7405-eng-26. 72p.

With the installation of the dee assembly and the shielding, the 86-in. cyclotron is structurally complete. The resonant system is being adjusted to improve oscillator performance. The 22-in. cyclotron is being operated as a test instrument for the study of beam efficiencies and beam deflection methods. Expressions for the "horizontal" and the "vertical" motions of ions in a fixed frequency cyclotron were formulated. The separation of intermediate-level U^{236} is nearing completion, and preliminary tests were made for the separation of thorium, bismuth, and plutonium isotopes. The 90° focus of a beam obtained from a flat-grid ion source was too broad to permit isotope separation; conditions which may account for beam spread are being investigated. Equipment for measuring low reaction cross sections is being tested. Studies of radiation damage and target design were initiated. (auth)

29298 ENRICHMENT OF LIGHT ISOTOPES OF SULPHUR, CARBON AND OXYGEN USING AN ANION EXCHANGER. Karl Erik Holmberg (Aktiebolaget Atomenergi, Studsvik, Sweden). Acta Chem. Scand., 16: 1045-6(1962). (In English)

An experiment was made on the enrichment of light sulfur isotopes at the boundary of adsorption of SO_2 from a solution on an anion exchanger column. Seven columns filled with Dowex 2-x10 in acetate form were connected in series and SO_2 pre-enriched in S^{32} absorbed on the columns. The SO_2 band was displaced with 0.3 M HCl, and after a travel of 116.5 m in 43 days, the band was divided into 8 samples for S isotopic analysis. The S^{34}/S^{32} separation factor between the band ends was found to be 20.3, corresponding to 471 theoretical plates. Four samples of the acetic acid effluent in front of the SO_2 band were also taken after 31 m travel for investigating the isotopic enrichment between acetic acid and acetate ion. The results show that the carboxyl of the acetic acid in solution is enriched in C^{13} by the factor 1.0016 and in O^{18} by the factor 1.0036. (D.L.C.)

29299 USE OF ETHYL ALCOHOL TO INCREASE THE YIELD OF THE SZILARD-CHALMERS REACTION WITH

ETHYL IODIDE. Carmelo Cappadona, Giovanni Fierotti, and Emanuele Sinagra (Comitato Nazionale Energia Nucleare, Rome). Atti Acad. sci. lettere ed arti Palermo, 20: 295-303(1959-60). (RT/CHI(62)8). (In Italian)

An alcoholic solution of ethyl iodide was subjected to the thermal neutron flux of Reactor "AGN 201 COSTANZA" in Palermo. The Szilard-Chalmers reaction was produced and I^{128} was liberated during the irradiation. The use of the ethyl alcohol as solvent minimized the retention. The gain in the yield seems to be very remarkable. (auth)

29300 RESULTS OF LOW TEMPERATURE RESEARCH. XXXVIII. THE SEPARATION FACTOR OF NITROGEN ISOTOPES IN THE NO/CH_4 SYSTEM. K. Clusius, U. Piesbergen, and E. Varde (Universität Zurich). Helv. Chim. Acta, 45: 1211-22(1962). (In German)

The abnormally large effect in the vapor pressure of isotopic nitrogen monoxide was usually traced back to the association equilibrium between individual molecular types in the condensate. According to this hypothesis, "monomerized" nitrogen oxide shows smaller isotopic effects than the usual liquids which are essentially composed of the $(NO)_2$ molecule. A dissociation of the dimer liquid nitrogen oxide can be obtained by dilution with a passive solvent. Therefore, liquid methane was selected. The state diagram of NO/CH_4 was thoroughly investigated at 111.2°K. A vapor pressure maximum of 786 mm Hg occurred at the mole fraction of 0.865 CH_4, whereas at this temperature pure methane has a vapor pressure of 731.1 mm Hg and nitrogen oxide, 206.7 mm Hg. Correspondingly the maximum heat of mixing is negative at $\gamma = 0.5$; it is -95.6 cal/mol. The Heitler theory was found to be a good approximation for the description of the ratios in the phase diagram. The system NO/CH_4 is the known azeotropic mixture at the lowest temperature which can be traced back to the special position of the NO radical. A 3% solution of nitrogen oxide with 42 at. % $N^{15}O$ in liquid methane was investigated for the separation parameter of the nitrogen isotopes between vapor and condensate. A value of 0.014 was obtained, whereas undiluted nitrogen oxide has a 2.3 times greater separation parameter of 0.031. This result satisfies the validity of the hypothesis that the isotopic effect depends decidedly on the association equilibrium in the condensate. (tr-auth)

29301 ISOTOPE EFFECT IN PHASE EQUILIBRIA. G. Boato, G. Casanova, and A. Levi (Università, Genoa and Istituto Nazionale di Fisica Nucleare, Genoa). J. Chem. Phys., 37: 201-2(July 1, 1962).

The theory of $\ln \alpha$, where α is the isotope separation factor in two-phase equilibria, is discussed. Equations for $\ln \alpha$ based on quasi-classical systems are given. The application of the equations to monoatomic systems, e.g., inert gases, are described. In solid-vapor equilibria, $\ln \alpha$ in a first approximation depends linearly on $1/T^2$, and crystal anharmonicity introduces a corrective term to $\ln \alpha$ proportional to $1/T$. In liquid-vapor equilibria, deviations of $\ln \alpha$ from a $(1/T^2)$ law are due to expansion of the liquid, and $\ln \alpha$ becomes zero at the critical temperature. These predictions agree well with experimental observations. (D.L.C.)

29302 THE DEPENDENCE OF THE ELECTROLYTIC HYDROGEN–DEUTERIUM SEPARATION FACTOR ON THE ELECTRODE POTENTIAL. Gerald P. Lewis and Paul Ruetschi (Carl F. Norberg Research Center, Yardley, Penna.). J. Phys. Chem., 66: 1487-92(Aug. 1962).

The influence of the electrode potential on the cathodic hydrogen-deuterium separation factor was determined with potentiostatic experiments. Additional variables studied were electrode materials, temperature, and surface roughness (porous vs. smooth electrodes). The separation factor S was found to pass through a maximum as increasingly negative electrode potentials were applied. The maximum for S occurred at a different potential for each electrode material. In the decreasing region at high negative potentials, the influence of the individual electrode material on S decreased, and the data for all electrodes merged and could be represented by a single line with a scatter of only 25%. The porous electrodes gave separation factors 10 to 100% smaller than the smooth electrodes. The separation factor decreased with increasing temperature by about 1% per °C in the range 30 to 50°. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 29492 and 30007.

29303 (ANL-6576) COMPILER INTO GEORGE ASSEMBLY ROUTINE. R. George (Argonne National Lab., Ill.). June 1962. Contract W-31-109-eng-38. 18p.

This program of the GEORGE Assembly Routine (GAR) will accept Fortran-like statements from paper tape and create the GAR language program on tape. This includes the needed calls for common subroutines and the reservations for the named variables and temporaries. The original statements in Fortran are carried along as remarks. The GAR language program may then be processed in the usual way by the GEORGE Assembly Routine, giving machine-language code. The level of sophistication of the source language is roughly equal to that of Fortransit or SALT. (auth)

29304 (KAPL-M-EC-19) SOR-II: A PROGRAM TO PERFORM STRESS ANALYSIS OF SHELLS OF REVOLUTION. Julius A. Mirabal and Donald G. Dight (Knolls Atomic Power Lab., Schenectady, N. Y.). June 1, 1962. Contract W-31-109-eng-52. 106p.

The program solves for the forces, deflections, stresses and strains in thin shells of revolution. The shells may be general surfaces of revolution with variable thicknesses and elastic moduli. This includes the more familiar forms; the circular flat plate, cone, cylinder, sphere, ellipse and tori with circular or elliptical cross sections, for which a simplified input is used. The axisymmetric loadings considered include arbitrary distributions of normal, tangential, and moment surface loadings, as well as edge forces and deflections. The effects of temperature variations in the meridional and thickness directions as well as centrifugal loading due to rotation about the axis and vibration are included. The program will solve and join together up to 10 shells. The additional effects of misalignment, line loads, and elastic supports at the shell intersections are considered. SOR-II numerically integrates the shell equations using a generalized Adams-Moulton method. The integration proceeds along the shell with automatic adjustment of interval size for maximum speed within the limitations of the preset error bounds. The integration error bounds, which may be altered by input, are preset to give for most cases, four significant figure accuracy. To insure optimum results, it is recommended that the maximum length of any one shell not exceed six attenuation lengths. The method used permits solution of problems in which the shell includes the axis of revolution. It also allows step changes in loadings and some shell properties. The timing depends on the number of shells being connected and the accuracy requested. However, an average time of 1.5 min/case was experienced. (auth)

29305 (NYO-2303) FRANTIC PROGRAM FOR ANALYSIS OF EXPONENTIAL GROWTH AND DECAY CURVES. Technical Report No. 76. Paul C. Rogers (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). June 1962. Contract AT(30-1)-905. 51p.

A computer program called FRANTIC was written for use in processing raw counting data and to fit these data, by the least squares techniques, equations for multiple exponential growth and decay. The program is written in FORTRAN for IBM computers and is sufficiently general to be used for almost any sum of exponentials with positive, negative, or zero exponents and positive or negative coefficients. FRANTIC is designed so that each independent group of operations, such as data processing, matrix inversion, and input-output routines, may be removed and modified or replaced without disturbing the remainder of the program. (J.R.D.)

29306 (PAN-298/VII) A SIMPLIFIED METHOD TO OBTAIN THE INFINITESIMAL OPERATORS OF THE HOMOGENEOUS LORENTZ GROUP. Bronislaw Kuchowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Jan. 1962. 14p.

It was shown by Neumark and others that irreducible representations of the proper Lorentz group are characterized by the numbers c and k_0, where k_0 must be non-negative and integral or half-integral, while c may be a complex number. The original method to obtain the explicit form of the infinitesimal operators of this group in its canonical basis is purely mathematical, and therefore it seemed necessary to give another method based on analogies with the standard angular momentum theory which is the best known application of group theory in quantum mechanics. The advantages of the method lie in the clear physical analogy and in introducing the eigenvalues of group invariants from the beginning. (auth)

29307 (TID-16302) TECHNICAL PROGRESS REPORT. PART I. CIRCUIT RESEARCH PROGRAM. PART II. MATHEMATICAL METHODS. PART III. DATA REDUCTION METHODS. PART IV. ILLIAC USE AND OPERATION. PART V. IBM 650 USE AND OPERATION. PART VI. INSTRUCTIONAL USE OF COMPUTERS. PART VII. CONTROL DATA CORPORATION 1604. PART VIII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). May 1962. Contract [AT(11-1)-415]. 44p.

Investigation of circuit flipflops of the Schmidt Trigger and the Eccles-Jordan type was initiated. In mathematical methods, a procedure for estimating the partition function of a quantum mechanical system is described. Activities in data reduction research were devoted to a high-resolution CRT scope system, programming, and computer components. Details of Illiac and IBM 650 use and operation are included. Other information is included concerning instructional use of computers, and administrative functions. (J.R.D.)

29308 SINGULAR ACTIONS OF LIE GROUPS. Robert Fred Lyjak (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 249-50(July 1962).

The equivalence of differentiable actions of a compact connected Lie group G, of dimension n-2, on a compact connected differentiable manifold X of dimension n is determined. It is shown that no simply connected Lie group G can act on a manifold X with $H_i(X) = 0$ for $i = 1, 2$. The dimensions are assumed to differ by two. (P.C.H.)

29309 CODES FOR REACTOR COMPUTATIONS. Bernard W. Roos (General Atomic Div., General Dynamics Corp., San Diego, Calif.) and Ward Sangren. Nucleonics, 20: No. 8, 132-3(Aug. 1962).

A list is given of 106 computer codes which have become available since the list in the Nov. 1961 Nucleonics issue. The originating company and the machine for which the code is written are given together with a brief description

of each code. The list is divided into the following groups: burnup, engineering, group diffusion, kinetics, Monte Carlo, physics, and transport. (D.L.C.)

29310 FUNCTION GENERATOR FOR ANALOGUE COMPUTERS. H. K. Skramstad, J. H. Wright, and L. Taback (to U. S. Atomic Energy Commission). U. S. Patent 3,012,729. Dec. 12, 1961.

An improved analogue computer is designed which can be used to determine the final ground position of radioactive fallout particles in an atomic cloud. The computer determines the fallout pattern on the basis of known wind velocity and direction at various altitudes, and intensity of radioactivity in the mushroom cloud as a function of particle size and initial height in the cloud. The output is then displayed on a cathode-ray tube so that the average or total luminance of the tube screen at any point represents the intensity of radioactive fallout at the geographical location represented by that point. (AEC)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

29311 (ARF-1213-2) NONDESTRUCTIVE METHODS OF EVALUATING COATING-METAL BONDS. First Quarterly Report, April 1–June 30, 1962. A. M. Baumanis and W. E. Lawrie (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 15, 1962. Contract AF 33(657)-8938. 27p.

Activities in a program for development of ultrasonic methods to examine the strength and continuity of ceramic-metal bonds are described. An ultrasonic interferometer was constructed to permit measurement of the elastic constants of coating-substrate systems. Development of this instrument has not progressed to the point where elastic constants can be determined. Other techniques for flaw detection are discussed including thermal effects on the Schlieren optical methods and application of Rayleigh waves for detection of normal cracks in diffusion coatings imposed on metallic substrates. (J.R.D.)

29312 (DMIC-171) THE PHYSICAL METALLURGY OF COBALT-BASE SUPERALLOYS. H. J. Wagner and A. M. Hall (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 6, 1962. Contract AF33(616)-7747. 84p.

A detailed picture is presented of the physical and chemical phenomena that affect the behavior of cobalt-base superalloys. Solid-solution strengthening is obtained from high-melting refractory-metal elements, Mo, W, Ta, and Nb. Precipitation of intermetallic compounds such as Ni_3Ti is also important. The relationships among microstructure, heat treatment, and mechanical properties are considered, and whenever possible, explained on the basis of the physical and chemical processes that occur. (auth)

29313 (DP-723) EVALUATION OF TANDEM-EXTRUDED JOINTS BETWEEN ZIRCALOY AND STAINLESS STEEL. J. Walter Joseph, Jr. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1962. Contract AT(07-2)-1. 15p.

Out-of-reactor testing of tandem-extruded tubular joints between Zircaloy and stainless steel indicated the suitability of the joints for use in the pressure tubes of a power reactor. (auth)

29314 (GEMP-13A) HIGH-TEMPERATURE MATERIALS PROGRAM. Progress Report No. 13, Part A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). July 31, 1962. Contract AT(40-1)-2847. 66p.

Progress is reported on development of metallic fuel element materials for greater than 1200°C operation in oxidizing atmospheres, development of high-temperature control materials, fabricability of high-temperature structural materials, effects of radiation on high-temperature alloys, moderator fabrication and testing, and high-temperature insulation materials. (M.C.G.)

29315 (HW-73540) DEVELOPMENT OF THE CATHODIC ETCHING OF METALS AT PRESSURES FROM ATMOSPHERIC TO THE GASEOUS DISCHARGE REGION. T. B. Correy (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1962. Contract AT (45-1)-1350. 48p.

It was found that a finite pressure of Ar gas will produce minimal surface roughness when cathodically etching Al, Cu, U, and Zircaloy-2 in an Ar atmosphere at pressures from atmospheric to 29.8 in. (755 mm) of Hg below atmospheric. A very thin film followed by a thicker one can be selectively etched from some metals. Etching spots on the same metals disclosed that for a constant current they did not all reach the same or a limiting diameter of spot in the same time. A superimposed radiofrequency current is used to maintain the discharge. Cathodically etching in the transfer region between streamer discharge and gaseous discharge and in the gaseous discharge region were totally unsatisfactory. Indications are that He can be used, but the etching rate is much lower for the same current and requires higher open-circuit potential for some metals. (auth)

29316 (IDO-14590) IMPROVED SAMPLE BONDING AND EMISSION WITH TANTALUM SURFACE IONIZATION FILAMENTS. Paul Goris (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 29, 1962. Contract AT(10-1)-205. 16p.

Techniques for conditioning of Ta filaments for improved bonding and emission with a Ta metal powder-Ta_2O_5 mixture are described. A porous Ta metal layer is deposited which restricts sample to the filament. Metal-oxide ion emission is enhanced with additional Ta_2O_5 to the porous layer. Reduction of fractionation through action of liquid Ta_2O_5 is discussed in particular for Sr^+ emission. Use of conditioned filaments for rapid U concentration analysis with a single-filament mass spectrometer is emphasized. (auth)

29317 (NP-11987) GALLIUM: BIBLIOGRAPHY ON PRINCIPLE PROPERTIES. Pierre de la Breteque (Société Française pour l'Industrie de l'Aluminium, Marseille and Aluminium-Industrie-Aktien-Gesellschaft, Neuhausen am Rheinfall, Switzerland). June 1962. 382p.

A bibliography on studies of gallium and its compounds from the date of its discovery, in 1875, to 1962 is presented. The 3180 references are arranged chronologically under the following topics: literature prior to 1900, general, geochemistry, preparation and purification, physical properties of element, physical properties of compounds (including semiconductors), chemical properties of element and compounds, biology, usages, and patents. An alphabetical index of authors and an index of Universities or Societies to which the authors belong are included. (M.C.G.)

29318 (TID-16386) PROJECT ON ANISOTROPIC DIFFUSION AND ELECTROMIGRATION. Annual Report. H. B. Huntington (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1962. Contract AT(30-1)-1044. 7p.

Studies concerning electromigration in Pt and Al are reported. Results on electromigration in Pt indicate that the electrostatic forces on the moving atom predominate over those of the "electron wind." In investigations continued from earlier report periods on the pattern of marker improvement in Pt under conditions of high d-c current flow, it was found that superposition of an electromigration effect occurs along with mass motion under the influence of a thermal gradient (Sôret effect). Studies of Al electromigration revealed that mass action is directed toward the anode and that the current density decreases with temperature. No Sôret effect was found in Al with d-c current. In other work, diffusion of Cd^{115m} and Au^{198} in Zn was measured. (J.R.D.)

29319 (USBM-U-952) METALLURGICAL QUARTERLY PROGRESS REPORT NO. 15 FOR THE PERIOD OF APRIL 1, 1962 THROUGH JUNE 30, 1962. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Contract AT(11-1)-599. 39p.

The phase diagram of the V–Hf system is approaching completion; only the determination of the V solvus remains. Melting points and a preliminary determination of phase boundaries, based on as-cast microstructure, were proposed for the Hf–Ir alloy system. Alloys of Dy, Er, Gd, and Sm, alloyed with Ca, Zr, V, Cr, Fe, Ni, Cu, and Al, were prepared and melting points, transition temperatures, eutectic and compound compositions, solid solubilities and oxidation properties are being studied. Of special interest is the fact that rare-earth Cu alloys of equal atomic ratios can be cold worked. Tolerance limits for O_2, N_2, and C were established in Nb–Ta welding. Pressure bonding appears to be the most satisfactory joining method. Preliminary studies of Hf–HfC systems indicate a phase diagram with peritectic and peritectoid reactions and limited C solid solubility. Techniques were devised for mixing, pressing, and sintering homogeneous compacts of Nb and Mo powder with 18% gadolinium oxide. In addition, preliminary forging schedules were established and a cursory survey of tensile properties was completed. Binary alloys of Th with Ho, Nd, and Pr were prepared that contain from 10 to 50% of these rare earths. Variations in alpha–beta transformation temperature, melting temperature, hardness, and recrystallization temperature were determined. Feasible small-scale procedures for electric resistance fusing and leaching that could be scaled up to commercial operations were developed for obtaining high extractions of Zr–Hf fluorides from zircon. Hf-enriched liquors with Hf–Zr ratios of about 6 were produced by single-stage fractional crystallization of Zr–Hf fluorides in dilute acid solutions. Measurements of coolant flow, heat dissipation and wall thickness as they affect cold-mold arc melting are continuing. Purification mechanisms and the establishment of identities of evaporating species when metals are melted in an electron-beam furnace are continuing. In the case of Hf, most metallic impurities and H_2 are removed during the first few minutes of melting. Cl, N_2, and O_2, in this order, were eliminated at a slower rate. Al, Zr, and Hf oxides are evaporated as monoxide; Cu, Fe, Cr, Mg, and Ti oxides tend to dissociate below the melting point of Hf and are evaporated as either the suboxides or as metallics. Hf–C systems varying from 2.72 to 15.7% C were prepared and evaluated for the following properties as a function of C content: melting point, density, microhardness, electric resistance, oxidation rate, and lattice dimension. The preparation of suitable electrodes for successful consumable-electrode arc melting of UC has been a major problem. The most useful, but not completely satisfactory, electrodes were prepared by mixing fine U saw cuttings with C and pressing at about 30 tsi. Sidewall fusing was required to provide strength and electric conductivity. (auth)

29320 (AEC-tr-5107) THE FORMATION AND DIFFUSION OF KINKS AS THE FUNDAMENTAL PROCESS OF DISLOCATION MOVEMENT IN INTERNAL FRICTION MEASUREMENTS. A. Seeger and P. Schiller. Translated by Gordon R. Love (Carnegie Inst. of Tech., Pittsburgh) from Acta Met., 10: 348-57(Apr. 1962). 22p.

The displacement of dislocation loops which do not lie in a single Peierls valley, but which make a small angle with one of the crystallographic directions of high Peierls stress was considered. That part of the dislocation which crosses over from one Peierls valley into the next is designated a kink. It is shown that kink motion is also responsible for a major part of the anelastic dislocation straining. A rough approximation for the amplitude of the kink motion indicated that, under the conditions of the usual damping measurements, this amplitude is larger than the amplitude of a string model by the factor l/na, where l is the length of the dislocation loop, a, the lattice parameter, and n, the number of kinks on a dislocation loop. The shape, width, and energy of kinks were calculated. The difference between geometric and thermal kinks is discussed. Expressions are given for the probability of the formation of kinks. The forces between kinks were determined. (M.C.G.)

29321 (AEC-tr-5247) INTRODUCTION TO THE STUDY AND THE USE OF ELECTROLYTIC POLISHING OF METALS AND ALLOYS. P. A. Jacquet. Translated from Metaux, corrosion, usure, 18: No. 209, 1-21(1943). 38p.

A discussion of the preparation of 0.1-cm^2 specimens for micrographic examination or physicochemical studies is presented. Included are sections on equipment, surface preparation, electrolytes and electrolyzing, and drying and polishing. Other information is included on advantages of electrolytic polishing and scientific applications. (J.R.D.)

29322 (AEC-tr-5248) HANDBOOK OF METAL PHYSICS. VOLUME II. THE HETEROGENEOUS EQUILIBRIUM. Rudolf Vogel—G. Masing, ed. Translated by Inez C. O'Brien (Los Alamos Scientific Lab., N. Mex.) from Chapter 4, Pt. 1, p.314-37 of "Handbuch der Metallphysik. Volume II. Die Heterogenen Gleichgewichte" (a publication of Akademische Verlagsgesellschaft m.b.H., Leipzig, 1937). 33p.

Equilibrium in a 3-component system is discussed. It is noted that the description of heterogeneous equilibrium in 3-component systems and the representation of its characteristics is presented most simply if the ternary equilibrium is developed from the binary equilibrium. The graphic expression depending on the temperature, pressure, and composition of the phases is found by means of the phase rule. Other information is included on equilibrium between ternary vapors and liquids, and equilibrium between several liquid phases in the absence of a vapor phase. (J.R.D.)

29323 (AEC-tr-5285) DETERMINATION OF OXYGEN AND NITROGEN IN TITANIUM SAMPLES BY MEANS OF A CONDENSED SPARK IN A VACUUM. J. Romand, H. Balloffet, and B. Vodar. Translated by Mickey Kivel (Ames Lab., Ames, Iowa) from Spectrochim. Acta, 15: 454-(1959). 13p.

A description is given of a triggered three-electrode vacuum spark, consisting of a main analytical spark initiated by a second auxiliary vacuum spark. The advantages of this arrangement for spectrochemical analysis are discussed, and some results are given concerning an application of this source to the determination of the O and N contents in Ti samples in the far ultra-violet region. (auth)

29324 (SCL-T-432) METHOD OF DEPOSITING SOLDERABLE METALLIC LAYERS ON CERAMICS. Curt Jung-Zaeper. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from German Patent P. B.-12537. Oct. 20, 1944. 5p.

A device is described for deposition of metal coatings on ceramics by vaporization in a vacuum. It is suggested that sintering be done in the same oven in such a way that

the coating acts as the conducting layer in the capacity of a cathode in a d-c discharge line, while the evaporating metallic portion serves as an anode. (J.R.D.)

29325 DEVELOPING SPECIAL CEMENTS TO RESIST TEMPERATURES OVER 4000°F. Kurt W. Cornely (American Thermocatalytic Corp., Mineola, N. Y.). Adhesives Age, 4: 26-7(Sept. 1961).

A stable high-temperature refractory cement was formulated from oxides and silicates of elements of the periodic group IV. The name of the cement is Astroceram, and it comes in two different types: Type A, which can be air-dried and has a maximum service temperature of 4300°F, and Type B, which must be fired to achieve a bond but can be used up to 5300°F. Some of its thermal, nuclear, mechanical, electric, and chemical properties are described. It also has excellent radiation resistance. (D.L.C.)

29326 NIOBIUM. F. Joly. Énergie nucléaire, 4: 189-203(May-June 1962). (In French)

The properties of niobium are reviewed. After a brief description of the principal Nb ores, extraction and purification processes, production techniques, and fabrication are discussed. The difficulties found in the production and fabrication of Nb—separation from Ta, high reactivity and affinity for oxygen and nitrogen, and the necessity for fabricating the metal in the absence of air—are briefly described. (J.S.R.)

29327 RADIOACTIVE METAL MOBILIZATION. A. Catsch (Inst. of Radiobiology, Karlsruhe, Ger.). Federation Proc., 20: Suppl. No. 10, 206-19(Sept. 1961). (KFK-76)

The potentialities, drawbacks, and limitations of ethylenediaminetetraacetic acid (EDTA) in the removal of radioactive metals are discussed. The biological effectiveness of EDTA is compared with that of several other chelating agents, with emphasis on $CaNa_3$-diethylene-triaminepentaacetic acid (DTPA). Data are tabulated on the effect of DTAA and EDTA on the retention of Y^{91}, Ce^{144}, Th^{234}, Pu^{239}, and Am^{241} in rats. Data are also tabulated on the effects of EDTA, DTPA, hydroxyethylenediaminetriacetic acid (HEDTA), and 1-2,-diaminecyclohexanetetraacetic acid (CDTA) on the retention of Ce^{144} in the organs of rats, the effects of Na polyphosphate (Graham's salt) on the retention of Y^{91}, Ce^{144}, and Pu^{239} in the liver, kidneys, and skeleton of rats. The effects of certain esterified polyamino acids are discussed and data are presented on the effects N'-(2-hydroxyethyl)ethylenediamine-N,-N,N'-triacetic acid (HEDTA) and derivative and N',N'-bis(2-hydroxycyclohexyl)ethylenediamine-N,N'-diacetic acid (DOC) administered as calcium sodium chelate (Ch) or respective ester lactone (E), on the distribution of Ce^{144} and Y^{91} in the organs of the rat. The effects of individual chelating agents on the removal of Sr^{89} and Sr^{90} are also reviewed. Reaction mechanisms involved and the effects of dose, time of administration, and chemical composition on the biological effectiveness of a number of chelating agents are discussed. It is concluded that DTPA is one of the more effective chelating agents. (C.H.)

29328 LESS COMMON METALS AND MODERN CHEMICAL PROCESSING. E. M. Sherwood. Ind. Eng. Chem., 54: No. 9, 57-61(Sept. 1962).

A review is given on the properties and chemical processing methods for Be, Cr, Hf, Mo, Nb, Re, Ta, W, and Zr. Protective coatings are also discussed. (P.C.H.)

29329 THE USE OF TANTALUM BORIDES FOR THE CONTAINMENT OF MOLTEN URANIUM AND CALCIUM. I. L. Jenkins and N. J. Keen (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 4: 387-9(Aug. 1962). (In English)

Tests with molten U and Ca were made on Ta crucibles coated with TaB or Ta_2B. Results showed that, while in the absence of thermal cycling, coated crucibles lasted longer than uncoated ones, a bond is formed between solidified U and the boride coat with consequent crucible failure on thermal cycling. High B contents of 25 to 1000 ppm were found in the solidified U and Ca after melting in coated crucibles. It is concluded that boride coatings cannot be recommended for Ta crucibles for containing molten U and Ca. (D.L.C.)

29330 NUCLEAR ROCKETS AND RAMJETS CHALLENGE TODAY'S MATERIALS. Metal Progr., 82: No. 3, 105-9(Sept. 1962).

Materials problems inherent in space propulsion systems center about the need for reliable, predictable performance at very high temperatures in a variety of environments. Examples include refractory fuel elements for a fission-powered rocket engine and homogeneous mixtures of beryllium oxide and uranium oxide required in fuel elements for a nuclear ramjet. (auth)

29331 CORREDUCTION FOR THE PREPARATION OF URANIUM-RICH ALLOYS. R. Gerhardt. Metall, 16: 643-6(July 1962). (In German)

Coreduction is compared with other methods for the preparation of U-rich alloys. The initial and reducing materials and the heat economy of the reaction are described. After a description of the reaction vessels, the procedure for carrying out the coreduction is sketched. Some research results which gave a summary of the adjustability and homogeneity of coreduced alloys are reported. (tr-auth)

29332 HAFNIUM. H. Sperner. Metall, 16: 679-82 (July 1962). (In German)

A brief survey is made of the methods for the production of Hf; fusion of the metal; physical, mechanical, and chemical properties; and its application possibilities. (J.S.R.)

29333 PREPARATION OF NIOBIUM-TIN WIRES FOR MICROSCOPY. T. P. Turnbull and H. H. Ehlers (Massachusetts Inst. of Tech., Lexington). Rev. Sci. Inst., 33: 876-7(Aug. 1962).

A method is described for preparing cross sections of Nb–Sn wire for microscopy. The wire (e.g., 0.007-in. dia) is placed in a quartz capillary of larger diameter (0.020-in. dia), with its end slightly below the ground end of the capillary, and the assembly is encapsulated in Trans-cotic powder or Bakelite, which is cured. The mold is then polished down to expose the end of the wire for etching with $HF-HNO_3-H_2O$. (D.L.C.)

29334 PROBLEMS OF PHYSICS IN METALS AND METAL STUDIES. V. N. Svechnikov. Voprosy Fiz. Metal. i Metalloved., Akad. Nauk Ukrain. S.S.R., Sbornik Nauch, Rabot, No. 14, 1-152(1962). (In Russian)

New metastable phases in transition metals, creep induced structural changes, atomic diffusion, and defect points in metals and alloys are analyzed in a collection of 18 articles. The effects of compression, thermal and mechanical treatments, and alloying additions on magnetic, electric, mechanical, and structural properties of metals and alloys are also discussed. (R.V.J.)

29335 CERMET FUEL ELEMENTS. G. W. Cunningham, D. E. Kizer, and S. J. Paprocki (Battelle Memorial Inst., Columbus, Ohio). p.483-506 of "Powder Metallurgy in the Nuclear Age. Fourth Plansee Seminar, June 20-24, 1961, Reutte/Tyrol." Reutte/Tyrol, Austria, Metallwerk Plansee A. G., 1962. (In English)

Results are presented of a study made to determine fabrication techniques and certain mechanical and physical properties of cermet fuel elements containing 60 to 90 volume per cent UO_2 in metallic skeletons of stainless steel, niobium, molybdenum, and chromium. Specimen preparation including the techniques for producing green compacts and hot isostatically pressed bodies are discussed. Values for transverse rupture strength, compressive strength, modulus of elasticity, and Poisson's ratio at room temperature are reported. Values for thermal and electrical conductivity and the coefficient of linear thermal expansion over the range room temperature to 900°C are listed. (auth)

Corrosion

29336 (AGC-0584-04-3) MERCURY CORROSION LOOP TESTING PROGRAM. Third Quarterly Report, April 1–June 30, 1962. (Aerojet-General Corp. Power/Equipment Div., Azusa, Calif.). Aug. 6, 1962. Contract NAS 3-1925. 26p.

The fabrication and testing in the Dynamic Mercury Corrosion Loop Testing Program are reported. Operation of the first of ten loops to be tested was begun, and a second loop was fabricated. Four of the test loops will be fabricated from Haynes 25 alloys while the remaining six will be fabricated from 316 stainless steel-clad (or unclad) Cr–Mo alloys or 316 stainless steel-clad Nb. (J.R.D.)

29337 (ARF-2198-26) IMPROVED ZIRCONIUM ALLOYS. Technical Progress Report, February 1, 1961–February 28, 1962. D. Weinstein and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Feb. 28, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(11-1)-578. 22p.

The development of zirconium-base alloys possessing exceptionally good corrosion resistance to 680°F water or 750°–900°F steam and/or improved strength at elevated temperatures with corrosion resistance equivalent to Zircaloy-2 was investigated. Approximately 100 binary compositions were screened by corrosion testing in 680°F water and 750°F steam; selected compositions were exposed to 900°F steam. Data obtained indicated a number of highly promising bases for ternary alloy studies in superheated water or steam. On the basis of 2000-hour tests, alloys were obtained which initially satisfy the objectives for 680°F water. The compositions are based on Zr-Nb, Zr-Sn, and Zr-Sb with ternary additions of Te, Ge, or Nb. Initial data for exposure to 750° and 900°F steam indicate very promising corrosion behavior of some ternary alloys. (auth)

29338 (GEAP-3462) ZIRCONIUM ALLOYS FOR STEAM SERVICE. A Preliminary Study. Harold H. Klepfer (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). June 24, 1960. Contract [AT(04-3)-189]. 63p. (R60APE8)

The fabricability, elevated temperature strength, steam corrosion resistance, and hydrogen pickup of various binary, ternary, and quaternary alloys of zirconium were studied. Preliminary results indicated that alloys having low hydrogen pickup and nodular hydride precipitate which are both stronger at elevated temperatures and more resistant to steam corrosion at high exposures than is Zircaloy-2 could be designed. Such alloys might contain combinations of the peritectoid formers Nb, V, and Cr. (auth)

29339 (GEAP-4025) STRESS CORROSION OF TYPE 304 STAINLESS STEEL IN SIMULATED SUPERHEAT REACTOR ENVIRONMENTS. Informal AEC Research and Development Report 568-TIO-2. G. G. Gaul, W. L. Pearl, and M. Siegler (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Feb. 26, 1962. Contract AT(04-3)-189. 42p.

A fuel jacket failure that occurred in May 1961 in the Type 304 stainless steel clad fuel element exposed in the Vallecitos Boiling Water Reactor superheated steam loop (SADE) was attributed to chloride stress corrosion cracking. In order to better understand the failure, a test program was carried out to try to reproduce the rapid stress corrosion attack in the simulated superheat reactor environment of the CL-1 superheat facility. The methods of corrosion testing under heat transfer conditions reported previously were modified: to apply a longitudinal stress on the test sheaths to produce a 0.1 per cent elongation in 1000 hours; to increase the chloride content of the moisture carryover with the steam by increasing the chloride in the recirculating water to 1.5 ppm; and to expose the solids deposits to various metal temperatures. After 1000 hours of exposure, no significant attack was noted on the test sheaths. The test procedures were further altered to simulate the significant amount of SADE fuel element exposure to saturated steam at varying temperatures with little to no superheat being generated. A 776-hour total exposure was carried out with the test conditions cycled several times. The entrance heater (calculated metal temperature during normal operation 800 to 900°F) was covered with numerous fine cracks that did not penetrate completely through the 0.030-inch sheath. The cracks were predominantly transgranular. Discontinuities were located by ultrasonic techniques in the middle (metal temperature ~1000°F) and exit (metal temperature ~1200°F) sheaths. The discontinuities were confirmed as intergranular penetrations of 0.006 to 0.010-inch depth respectively by metallography. Both types of attack were found on the SADE fuel element cladding failure. Chloride salts of chromium, copper, iron, and nickel were found by x-ray diffraction in the deposit taken from the test sheaths. Some laboratory tests with unsensitized and sensitized Type 304 stainless indicated that water solutions of copper or iron chloride salts chemically attacked the sensitized material intergranularly independent of stress. The test results indicated that chemical and chloride stress corrosion attack can act either singularly or in combination to produce the type failures experienced in the SADE and CL-1 tests. The presence of stress had little apparent effect on the uniform corrosion rate of the test sheaths, except when the stresses were high enough to cause creep. The creep resulted in scale spalling with some accelerated corrosion in the areas of scale cracking. (auth)

29340 (KAPL-M-LRM-2) STATIC SODIUM CORROSION TESTS OF CERAMIC MATERIALS. L. R. McCreight (Knolls Atomic Power Lab., Schenectady, N. Y.). July 6, 1951. Contract [W-31-109-Eng-52]. 5p.

Static corrosion tests using aged and filtered sodium were run on 68 different specimens of non-metallic material. All specimens were tested at 500°C for one month then thirteen were selected for retesting at 750°C for another month. No definite correlation of corrosion rate and chemical composition between similar compositions was found. Data are tabulated. (P.C.H.)

29341 (NP-11990) HIGH-TEMPERATURE OXIDATION-RESISTANT COATINGS FOR TANTALUM BASE ALLOYS. Third Quarterly Progress Report, May 1, 1962–

July 31, 1962. L. Sama (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). Aug. 20, 1962. Contract AF 33(657)-7339. 32p. (TR 62-460.4)

Tests were made to determine optimum Sn–Al coating compositions on Ta–10 W and Ta–30 Nb–7½ V alloys. Coating losses were considerable during exposure to environments of 0.1 to 100 microns pressure at 2500 to 2800°F for one hour. Little improvement was obtained by preoxidation at various temperatures. Temperature gradient samples tested at a maximum of 3000°F showed significant differences in diffusion penetration behavior between the two alloys. Several techniques were used to obtain considerably thicker coatings and to minimize run-off of the Sn–Al during diffusion treatment. Pretitanizing prevented run-off but decreased oxidation resistance somewhat. Several new coatings were also investigated. Additions of yttrium to the Sn–Al slurries resulted in some coatings with unstable room temperature behavior and none of the coatings showed superior properties to those previously developed. Calorize-spray and calorize-hot dip Sn–Al coatings were found to be inferior in oxidation resistance to slurry coatings. The use of Sn–Si slurries was not successful. However, pack-siliciding over a titanized base gave coatings with good oxidation resistance to 2800°F, particularly on the Ta–10 W alloy. Maximum temperature capability of the Ti–Si coating is several hundred degrees below the Sn–Al coating. (auth)

29342 (ORNL-TM-293) HIGH-TEMPERATURE REACTIONS OF TYPE 304 STAINLESS STEEL IN LOW CONCENTRATIONS OF CARBON DIOXIDE AND CARBON MONOXIDE. H. Inouye (Oak Ridge National Lab., Tenn.). Aug. 29, 1962. Contract W-7405-eng-26. 49p.

Compatibility studies of type 304 stainless steel in helium containing low concentrations of CO and CO_2 were conducted. The oxidation rates were insensitive to impurity concentrations between 0.0006–0.3 vol % in the temperature range 400–1000°C when P_{CO_2}/P_{CO} was less than 0.66. Ratios above this value resulted initially in a slow oxidation rate, but was followed by an accelerated attack. The incubation period for the break-away varied with the P_{CO_2}/P_{CO} ratio and the pressure of the two gases. The oxidation reactions proceeded through a selective depletion of chromium from the alloy which increased the carbon solubility and depletion of nickel which led to the transformation of austenite to ferrite. Parabolic reaction rates were observed for the formation of the protective oxides. Arrhenius plots of rate constants versus 1/T indicated the presence of several oxides which was confirmed by other methods. Carburization or decarburization reactions occurred coincidentally with oxidation and depended upon temperature and $(P_{CO})^2/P_{CO_2}$ and the P_{CO_2}/P_{CO}. Neither was detected below 600°C. Between 600–900°C, only carburization occurred and appeared to be mainly dependent on the temperature. Above 900°C, both carburization and decarburization occurred depending upon the $(P_{CO})^2/P_{CO_2}$ and the P_{CO_2}/P_{CO}. The interactions of the oxidizing and carburization reactions resulted in carbon maxima at a $(P_{CO})^2/P_{CO_2}$ ratio of 0.227. The results indicate that it may be impractical or unnecessary to reduce impurity gases to levels which do not cause surface reactions. It is concluded that undesirable oxidation and carburization reactions can be eliminated by controlling the ratios of the impurity gases. (auth)

29343 (ORNL-TM-294) "LIFE" TESTS ON INTERNALLY WATER-COOLED HOLLOW COPPER CONDUCTORS. J. Lewin (Oak Ridge National Lab., Tenn.). July 18, 1962. Contract [W-7405-Eng-26]. 32p.

Tests were conducted to determine whether a time limitation exists on the use of internally water-cooled hollow copper conductors operating at densities of up to 330,000 amps/in^2. Using demineralized water, having a specific resistivity of 4 to 9×10^6 ohm-cm, no indication of a decrease in heat transfer coefficient as a function of time was observed. However, metallographic examination revealed that corrosion–erosion does occur at a slow rate. Using process water there was a time dependent decrease in heat transfer coefficient and a consequent rise in metal temperature. The subsequent use of demineralized water in the same conductor again produced stable heat transfer, over the time spans investigated, 192 hours. The maximum total time investigated was 873 hours for one conductor. (auth)

29344 (AEC-tr-5303) COMPATIBILITY OF STRUCTURAL STEELS AND CARBON DIOXIDE UNDER PRESSURE AND AT AVERAGE TEMPERATURES. R. Darras, D. Leclercq, and H. Loriers (Centre d'Etudes Nucleaires, Saclay, France). Translation of IAEA Preprint CN-13/39. 21p. (Includes original, 26p.)

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 22556.

29345 (EURAEC-228) CORROSION PROBLEMS. VOLUME 1. TEXT. VOLUME 2. ANNEXES. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude de l'Energie Nucléaire; and Brussels. Société d'Etudes, de Recherches et d'Applications pour l'Industrie). Jan. 1962. Work performed under United States-Euratom Joint Research and Development Program. Contracts 006-60-3RDB; 005-60-3RDB; and 007360-3RDB. 84p. A translation.

Test cells for use with and without irradiation were constructed. In corrosion tests without irradiation, the effects of chloride and oxidizers on the behavior of stainless steels in bicarbonate solutions were studied along with the corrosion of AISI 304, 316, and 410 chlorinated at 80°C in bicarbonate solutions. Other work without irradiation was continued on the behavior of boiler steels at 25°C in alkaline solutions containing sulfates. In corrosion studies concerning Al in salt spray, it was found that the surface state of the sample is the main factor controlling corrosion rate. Studies without irradiation of Zr were also conducted, and results of potential-time curves for polished specimens exposed to dry air were obtained. Similar measurements were initiated with Al samples. Potential-time curves were also obtained for iron specimens in bicarbonate and sulfuric acid environments which indicate that higher positive value in breakthrough potentials involve longer activation times. A potentio-kinetic test with irradiation of 304 steel in bicarbonate solution showed a slight increase in the cathodic current as the only difference from out-of-reactor tests. (J.R.D.)

29346 THE CORROSION BEHAVIOR OF THE NICKEL–CHROMIUM ALLOY INCONEL AND INCONEL AND NIOBIUM ALLOYS IN A PRESSURIZED WATER REACTOR. [PART] II. Warren E. Berry. Énergie nucléaire, 4: 204-16(May-June 1962). (In French)

The corrosion behavior of a series of Nb alloys in static water at 315 and 360°C and in 400°C steam at 100 atm is reported. The alloy compositions, exposure conditions, and results are shown in tabular form. Alloys investigated were Nb–V, Nb–Zr, Nb–W, Nb–Mo, Nb–Fe, Nb–Ti, Nb–Ti–Cr, Nb–V–Ni, Nb–Ti–Mo, Nb–Ti–V, Nb–Zr–Ti, Nb–Zr–V, Nb–Zr–Mo, Nb–Zr–Al,

Nb–Zr–Cr, Nb–Zr–Fe, Nb–V–Al, Nb–V–Cr, Nb–V–Ti, and Nb–Ni. (J.S.R.)

29347 ZASHCHITA NIOBIYA OT VYSOKOTEMPERATURNOI GAZOVOI KORROZII. (Protection of Niobium from High-temperature Gas Corrosion). A. I. Borisenko. Moscow, Izd-vo AN SSSR, 1961. 39p.

Oxidation and contamination resistance of Nb was studied, and various protective measures against high-temperature corrosion by gases are discussed. A detailed analysis is made of various protective coatings and of alloying as an oxidation preventative. 39 references are included. (R.V.J.)

Fabrication

Refer also to abstract 30009.

29348 (ARF-2231-5) PILOT EVALUATION OF VANADIUM ALLOYS. Bimonthly Report No. 5, May 18, 1962 to July 17, 1962. B. C. Rajala and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 14, 1962. Contract NOw 62-0101-c. 15p.

Experimental 200-gram Nb-V alloys were fabricated by hot, warm, and cold working techniques. At 2400°F, V-5 wt % Ti-20 wt % Nb base compositions complexed with carbon, oxygen, and/or nitrogen had ultimate tensile strengths in the range of 7,900 to 9,500 psi. When 1 or 2 wt % zirconium in combination with carbon was added to the V-20 wt % Nb base, 2400°F strengths increased to about 12,500 psi. The addition of 10 wt % tantalum or tungsten to the V-20 wt % Nb base produced ultimate tensile strength values of 15,500 psi at 2400°F. At the 60 wt % niobium level, the composition V-1 wt % Ti-60 wt % Nb-2.5 wt % Mo-0.5 wt % Ru had a 2400°F strength of 21,300 psi. A 100-pound V-1 wt % Ti-60 wt % Nb ingot weighed 65 pounds after scalping. Subsequent extrusion at a 4 to 1 ratio yielded a 39-pound sheet bar; major losses were due to a pipe in the ingot and to surface checking during extrusion. Warm rolling operations on the bar have progressed. (auth)

29349 (ASD-TR-7-793(IV)) TUNGSTEN EXTRUSION DEVELOPMENT PROGRAM. Interim Technical Engineering Report, April 20, 1962–June 20, 1962. A. E. Riesen (Wah Chang Corp., Albany, Ore.). Contract AF 33(600)-42395. 46p.

A solid round extrusion of as-cast W–3Mo alloy was partially accomplished from 3200°F at a reduction ratio of about 16.4 : 1 and only 88% of liner capacity. Billet temperature of about 3200°F was established as the starting temperature for the extrusion of T shapes at a reduction ratio of about 17 : 1. Nitriding and sulfidizing die surfaces prior to coating and diffusion treated, zirconia coated dies did not progress sufficiently to properly evaluate these processes for extrusion purposes. T shape extrusions of cast W–3Mo alloy were accomplished from 3100–3200°F at a reduction ratio of about 18 : 1. These extrusions were made to study die glass composition and associated hardening point. Good dimensional run-out and light glass rub-in resulted from the use of soft rather than hard die glass. Good extrusion results were obtained with an extrusion die having a basic included entry angle of 130 degrees, $\frac{1}{4}$-inch constant land, minimum entry radius of $\frac{3}{16}$-inch to a maximum entry radius of $\frac{5}{16}$-inch, a surface hardness of Rockwell C 48 to 50 and protected by 0.030 to 0.040-inch thick coating of zirconia applied by the oxyacetylene flame-spray process with solid-rod feed. Die surfaces roughened to at least 500 rms appeared essential for sufficient bond strength with the zirconia coating. (auth)

29350 (ASD-TR-61-706(Vol.II)) BERYLLIUM COMPOSITE STRUCTURES. VOLUME II. MATERIALS AND PROCESSES. J. N. Krusos, A. S. Kjelby, J. Borosic, and T. J. Byrne (Aeronca Mfg. Corp., Middletown, Ohio). Jan. 1962. Contract AF33(616)-7050. 312p. (ER-532(Vol.II)).

Methods developed for the fabrication of beryllium sheet composite structures are given. Descriptions and performance evaluation are included for a variety of beryllium load bearing panels and porous ceramic heat shields developed to withstand temperatures in excess of 3000°F. Concepts are outlined defining application of beryllium-ceramic composites to aerospace vehicle structures. Beryllium sheet fabrication methods and tooling are described in detail and include such processes as cutting, forming, chem-milling, and brazing. Beryllium sheet faces were brazed to a variety of superalloy and stainless steel honeycomb cores. Flat, curved, and double curved panels were constructed with maximum dimensions of 18 in. × 18 in. Three basic porous ceramic foams were developed in the heat shield: alumina, zirconia, and silica. In all cases, the ceramic was reinforced with a superalloy honeycomb foil which was coated to attain a high oxidation resistance. The heat shields demonstrated excellent resistance to severe thermal and dynamic loads provided by tests in the exhausts of turbojet and ramjet engines. (auth)

29351 (CARDE-TM-280/59) THE EXPLOSIVE FORMING OF CONICAL SHAPES BY METAL GATHERING. H. P. Tardif (Canada. Armament Research and Development Establishment, Valcartier, Que.). Feb. 1958. 8p.

A method using metal gathering which gives increased wall thicknesses was developed for preparing shapes having a large ratio of height to base-diameter such as a sharp angle cone by explosive forming. (M.C.G.)

29352 (EURAEC-304) NON-DESTRUCTIVE TEST WELDING. Quarterly Report No. 3, January-March 1962. (Röntgen Technische Dienst N. V., Rotterdam). Apr. 27, 1962. Work Performed under United States-Euratom Joint Research and Development Program. 33p.

The wrought steel blocks, 100-, 200-, and 300-mm thick, were examined in the same way as the rolled blocks, as described in report X 200/2/1962 (quarterly report No. 2). The 100-mm-thick block contains in the middle a zone of impurities, which can be used for examining these effects on the seam measurements in the test sample (rolled plate and wrought steel block). The 200-mm-thick wrought steel block contains a large amount of impurities in the marginal zones. As the rolled plate (thickness 200 mm), with which a welded test sample must be made, also contains impurities in the marginal zone, the 200-mm-thick wrought steel block is not suited for further investigation. A new 200-mm block was ordered. The 300-mm-thick block contains practically no impurities. Several photographs were made of the test block by means of a sample of cobalt-60, as described in report X 200/1/1962. Examination of these photographs revealed a need to cancel the effects of secondary radiations. Methods of accomplishing this are being studied. (auth)

29353 (NMI-7217) EVALUATION OF ZIRCALOY-CLAD U–0.3 w/o Al–0.5 w/o Si TUBE NO. 135. W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). June 29, 1962. 26p.

Evaluation data on the U–0.3 wt % Al–0.5 wt % Si (Zircaloy clad) tube showed that it meets irradiation speci-

fications. Billet design, components, preparation, machining, inspection, extrusion, heat treatment, and post-extrusion evaluations are described. (M.C.G.)

29354 (NP-11994) ROLLING IMPROVED BERYLLIUM SHEET. PHASE I REPORT. TECHNOLOGY INVESTIGATION AND EXPERIMENTAL ROLLING. Technical Report 269-234, July 5, 1961 to February 4, 1962. E. M. Grala, R. G. O'Rourke, G. L. Marsh, and L. S. Busch (Brush Beryllium Co., Cleveland). July 1962. Includes Appendix: I: BEND TEST PROCEDURE (THIN RECTANGULAR CROSS SECTION SHEET). J. N. Hurd. Contract AF 33(600)-43037. 96p.

Systematic differences in beryllium sheet were revealed by an analysis of variance of commercial sheet. A process control and reproducibility study showed that the differences in beryllium sheet are caused by systematic differences between and within hot-pressed billets used for rolling slabs. The rolling process was found to be under control. Causes of variation in tensile elongation were found to be operative within small volumes of single sheet. Breakdown and finish rolling in the temperature range 1800–1600°F produced a coarse grain size and very low tensile elongation. Reduction ratio was found to have a large effect on the third dimension plastic strain of cross rolled beryllium sheet. Finishing operations such as creep flattening, roller leveling, and roll planishing were investigated, and the effect of these operations on the flatness and tensile properties of beryllium sheet is reported. The effect of various pickling solutions on the bend and tensile properties of beryllium was also studied. (auth)

29355 (ORO-546) HELICAL FINNED TUBE DEVELOPMENT, FEBRUARY 19–MARCH 17, 1962. E. A. Murphy and J. G. Klein (Brush Beryllium Co., Cleveland). Contract AT(40-1)-2912. 10p.

Progress is reported on the development of a fabrication technique that will produce high-quality finned beryllium tubing which has resistance to brittle failure under circumferential stress. Results of warm extrusion and warm drawing are presented. (M.C.G.)

29356 (ORO-577) MATERIALS FOR HIGH TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Progress Report No. 3, August 15, 1960–August 15, 1961. J. D. Fleming and J. W. Johnson (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-2483. 149p.

Activities in a program to evaluate fused silica for use as a reactor material are reported. Efforts devoted to optimization of slip casting methods for ceramics are also reported. Other work is reported on development of fabrication processes for materials which exothermically provide the necessary fabrication temperatures. Al and Be reduction of uranium oxides were studied. Experimental data and information are included on slip-cast fused silica, slip casting mechanisms, and thermet fuel elements. Analyses of a vibration experiment, a ring test, and the one-sided permeation system are included along with an evaluation of an air displacement porosity system. (J.R.D.)

29357 (UCRL-6391) VACUUM FURNACE BRAZING OF BERYLLIUM. Eldon F. Westlund (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 1961. Contract W-7405-eng-48. 18p.

Vacuum brazing techniques were developed for joining beryllium to titanium, stainless steel and to itself using silver as the filler. Shear strengths of about 20,000 psi were obtained for all three types of brazes. When brazing beryllium to titanium or to stainless steel, excessive brazing temperatures or holding times result in low-strength brazes. Both brazes can be made at temperatures as low as 900°C which is 60° below the melting point of pure silver. Initially, difficulty was experienced in obtaining consistently good brazes when joining beryllium to itself due to poor wetting by the silver. This was overcome by adding a small amount of titanium hydride to the beryllium contact surface. High strength brazes were consistently produced at temperatures from 960 to 1070°C showing that overheating was not a problem. (auth)

29358 (EURAEC-244) NON-DESTRUCTIVE WELDING INVESTIGATION. Quarterly Report No. 2, November 24, 1961 to February 8, 1962. (Röntgen Technische Dienst N. V., Rotterdam). Feb. 8, 1962. Work performed under United States-Euratom Joint Research and Development Program. Contract 045/61/5RDH. 43p. A translation.

The rolled steel in thicknesses of 50, 100, 200 and 300 mm. intended for the test pieces to be welding was subjected to an extensive investigation. In addition to ultrasonic research with both straight and angular probers, a magnetic investigation was also carried out on the sectional surfaces. It was noted that one of the plates (200-mm. thick) had rolling defects, the greatest of which had a length of at least 25 mm. in one direction. The disturbing influence of these discontinuities in the material on the noise transmission when using an angular prober was also investigated. A difference of at least 4.5 db was found on one of the points selected for further study. The impression is that this sheet forms a particularly good study object in the condition found, in comparison with the other sheets which show no great divergences, and that later on the influence of the impurities in the material and the rolling defects on the measuring sensitivity can thus be studied in the course of the next ultrasonic investigation. Furthermore, the influence of absorption on the measuring sensitivity was checked by means of tests on 200- and 300-mm. thick material. (auth)

29359 (EURAEC-251) ELECTRIC-SLAG-WELDING OF REACTOR STEELS. Technical Quarterly Report No. 2, November 1, 1961 to December 31, 1961. (Schweisstechnische Lehr- und Versuchanstalt, Duisburg, Germany). Jan. 31, 1962. Work performed under United States - Euratom Joint Research and Development Program. Contract 046-61-3RDA. 67p. A translation.

Welding tests on reactor steels using welding rods and fluxes of various compositions are reported. Seven iron-base welding rods with various compositions were tested in combination with five welding fluxes. Data concerning compositions, conditions, and other information are tabulated along with a computation of all experimental results. It was found that no benefits accrued from addition of Ti to the welding rods. Addition of Ni to the welding rods improved notch impact strength of the weld, and a considerable improvement was observed in the notch impact strength of welds formed by the use of low P content rods. The Arcos flux, composed of 23.14% SiO_2, 8.90% MnO, 15.70% Al_2O_3, 0.90% TiO_2, 11.90% MgO, and 2.34% Fe_2O_3, was found best among those tested. (J.R.D.)

29360 (EURAEC-272) STAINLESS STEEL PLATING OF HIGH THICKNESS STEEL. Quarterly Report No. 1, September through December 1961. (Ghent. Universiteit and Soudometal, S. A., Brussels). Work performed under United States–Euratom Joint Research and Development Program. Contract 040-61-9RDB. 18p. A translation.

Activities in a program to plate C steels with stainless steel are reported. Welding processes investigated include

manual arc welding with coated electrodes, arc series in which the part is not used to close the circuit, and the submerged arc ribbon processes. Comparison of the methods on the basis of pinpoint analysis of the components by x-ray spectrography is in progress. First results of pinpoint analysis are given for minimum and maximum dilution of the deposited metal. (J.R.D.)

29361 (EURAEC-273) WELDING OF VERY THICK STEELS. Quarterly Report No. 1, September 1 to December 31, 1961. (Ghent. Rijksuniversiteit and Soudometal, S. A., Brussels). Work performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9RDB. 163p. A translation.

Establishment of a preliminary welding study program is described. Included are results of investigations concerning problems associated with construction of presently used reactor vessels, summaries of the most prominent brittle fracture studies, and theories in the literature relative to the brittle fracture phenomenon. Other information is included on criteria to be used in studies of susceptibility to brittle fracture. Research activities during the period were devoted to studies concerning the effects of welding methods, filler products, confined atmospheres, impact strength in thick joints, and embrittlement of basic metals by plastic strain at various temperatures. Resulting experimental data are included which indicate that welding with string beads generally improves the impact strengths on deposited metal and that integral joint strains have a marked effect on the final properties. Conclusions concerning the effects of filler products are also included. (J.R.D.)

29362 POWDER METALLURGY — THE STATE OF THE ART. George W. Cunningham. Battelle Tech. Rev., 11: No. 8, 3-9(Aug. 1962).

Advances in powder metallurgy are surveyed with some reference to reactor fuel element applications. Various techniques, e.g., sintering, rolling, extrusion, cold compacting, etc., are described briefly. Applications of ceramic techniques to powder metallurgy are discussed. Explosive compaction is discussed as a method of increasing compact density. Other techniques discussed are continuous compacting, isostatic pressing, plasma arc spraying, reaction sintering, vibratory compacting, ultrahigh temperature-pressure processes, and electrophoretic deposition. Future applications are discussed briefly. (D.L.C.)

29363 HIGH-PRESSURE HOT-PRESSING OF URANIUM CARBIDE POWDERS AND MECHANISM OF SINTERING OF REFRACTORY BODIES. R. Chang and C. G. Rhodes (Atomics International, Inc., Canoga Park, Calif.). J. Am. Ceram. Soc., 45: 379-82(Aug. 1962).

Forty-mesh uranium carbide powders were hot-pressed in the temperature range 500 to 1500°C under pressures varying from 10,000 to 46,000 atm. Microstructural investigations of the compacts revealed grain-boundary sliding and fragmentation as important sintering mechanisms. (auth)

Properties and Structure

29364 (AERE-X/R-376) THE URANIUM–IRON SYSTEM. (Gt. Brit. National Lab., Teddington, Middx., England). May 31, 1949. 14p.

An investigation of the U–Fe system showed that the solubility of iron in solid uranium increases with temperature from about 0.004 wt % (0.018 at. %) at 600°C to 0.35 wt % (1.5 at. %) at 805°C, the temperature at which the solid solubility curve meets the solidus and also a peritectic horizontal line, where liquid reacts with solid uranium to form the compound U_6Fe. No discontinuous change in solubility was detected at the transformation of α into β uranium but at the transformation of β into γ the solubility suddenly increases from 0.1 to 0.2 wt % (0.4 to 0.8 at. %). The liquidus meets the peritectic horizontal at about 5 wt % (18 at. %) iron. The compound U_6Fe forms a eutectic, which contains about 11 wt % (34 at. %) iron and melts at 725°C, with UFe_2. The compound UFe_2 melts at 1230°C and forms a eutectic, which contains about 47 wt % (78 at. %) iron and melts at 1055°C, with iron. (P.C.H.)

29365 (ASD-TR-61-706(Vol.I)) BERYLLIUM COMPOSITE STRUCTURES. VOLUME I. DESIGN AND APPLICATION. J. N. Krusos, A. S. Kjelby, J. Borosic, T. T. Byrne, F. B. Eck, R. E. Wiegert, and V. Rosa (Aeronca Mfg. Corp., Middletown, Ohio). Jan. 1962. Contract AF33(616)-7050. 169p. (ER-532(Vol.I)

Design information is presented for beryllium and ceramic composite structures for re-entry vehicle applications. A summary of materials and process developments for beryllium panels and heat shield ceramics, analytical evaluations, and discussion of the application of insulated structural concepts to re-entry vehicle systems is given. Also included are the results of panel tests in the severe environments of turbojet and ramjet exhausts. Data suitable for preliminary design considerations are presented for three reinforced heat shield ceramic foams: alumina, silica, and zirconia. Beryllium sandwich panels are described with regard to fabrication potential and performance in aerospace structures. (auth)

29366 (AWRE-O-42/62) TENSILE FRACTURE CHARACTERISTICS OF EXTRUDED INGOT BERYLLIUM AND BERYLLIUM–IRON ALLOYS. W. Taylor and A. Moore (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1962. 24p.

Tensile tests were carried out between 20 and 600°C on three extruded ingot beryllium–iron alloys, having iron contents within the range 0.024 wt % Fe–0.40 wt % Fe. The materials were tested both in the as-extruded condition, and after heat treatments designed to overage the metal with respect to its iron content. Tests were performed on transverse, as well as longitudinal specimens, with respect to the extrusion axis, in order to obtain an indication of the influence of texture variation upon the tensile behavior. Deformation and fracture types produced in the tests were studied and related to the testing temperature, purity, thermal history, and mechanical properties of the specimen. The observations are briefly discussed in the light of current knowledge and theory pertaining to the deformation behavior of beryllium. (auth)

29367 (BMI-X-10011) CRACK INITIATION AND PROPAGATION IN URANIUM AT ELEVATED TEMPERATURES. N. E. Daniel, F. R. Shober, E. L. Foster, Jr., and R. F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Aug. 1, 1962. Contract [W-7405-eng-92]. 29p.

Uranium tensile specimens prepared from high-carbon uranium were tested at 20, 175, 250, 275, 300, 325, 350, 400, and 450°C in vacuo at a strain rate of 0.0005-in./in./min. The material exhibited a secondary minimum in ductility of 14.5% at 300°C. Metallographic examinations of the specimens after testing failed to reveal any evidence of grain-boundary cracking. Dynamic-modulus data on similar material were obtained at temperatures up to

1200°F with no indication of a drastic rate of change in this elastic property. (auth)

29368 (BNL-5113) DIFFUSION OF XENON THROUGH ALUMINUM AND STAINLESS STEEL. A. W. Castleman, F. E. Hoffmann, and A. M. Eshaya (Brookhaven National Lab., Upton, N. Y.). July 1960. Contract [AT(30-2)-Gen-16]. 22p.

Studies on the diffusion of xenon through aluminum, stainless steel, and the Piqua fuel element cladding by a radioactive tracer technique are reported. Xenon was not found to diffuse through aluminum in the temperature range 295 to 473°C. Stainless steel specimens showed no evidence of xenon diffusion up to 610°C. A maximum value for xenon permeability through the Piqua fuel element cladding is given; however, since the experimentally determined values lack correlation with temperature, they appear to be anomalous. (auth)

29369 (GA-1934) FISSION-PRODUCT PLATEOUT FROM A HELIUM GAS STREAM. Dale E. Johnson, J. Martin Tobin, and J. D. Buchanan (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 10, 1961. Contract AT(04-3)-187. 7p.

The experimental procedures used and the results obtained in studying the plateout of nongaseous fission products that may escape from a helium gas stream are discussed. Results show that significant quantities of high-activity fission products are volatilized from powdered uranium dioxide at 1800°F, and the gross activity for each of the materials (Nichrome, type 302 stainless steel, and quartz) exposed to the fission product vapors follows the same general pattern. Some indication is given that high nickel content promotes plateout at high temperatures as is shown by testing nickel, Nichrome, types 310 and 405 stainless steel, and quartz. Radioisotopes that were identified as being deposited on the specimens were iodine-131 and -133, molybdenum-99, ruthenium-103, and tellurium-132. Plateout occurred on all of the materials exposed to the helium stream from 1700 to 400°F. (N.W.R.)

29370 (GEAP-3216) POST-IRRADIATION EXAMINATION OF CORED, EDGE LOADED, THORIA–URANIA NUCLEAR FUEL. T. J. Slosek (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.). July 15, 1959. Contract N8-S-452. 34p.

In a program devoted to development of a reactor fuel capable of operating at high heat flux, specific power, and burnup, three edge-loaded thoria–urania nuclear fuel samples were assembled into a capsule, irradiated to approximately 2000 Mwd/t at a maximum surface heat flux of 10^6 Btu/hr/ft^2, and examined. Post-irradiation examinations indicated good fuel stability even in samples whose cladding had ruptured. The circumferential ruptures appeared to be caused by stresses induced from cycling of longitudinal thermal gradients in the stainless cladding material. This irradiation was the first of a series to develop thoria–urania fuel for high heat flux, specific power, and burn-up operation in a sodium graphite reactor. (auth)

29371 (HW-67939) THE EFFECT OF CLADDING RESTRAINT ON REACTOR FUEL ELEMENT DEFORMATIONS. Kenneth R. Merckx (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 28, 1960. Contract [AT(45-1)-1350]. 22p.

An analysis for a metallic tubular fuel element was developed which accounts for the plastic deformations of the fuel material and the cladding material. This analysis predicts the strain and stress distributions in both the fuel material and the cladding material. Sample calculations are given for various fuel material models, fuel material expansions, cladding dimensions, and fuel material radial dimensions. The results of numerical calculations for a Zircaloy-clad uranium fuel element indicated that doubling the yield strength of the fuel material from 500 to 1000 psi did not make significant changes in the cladding strains. Reductions of up to 40% in the exterior cladding circumferential strains are predicted by increasing outer fuel element cladding thickness, increasing the fuel element radius, or decreasing the inner cladding thickness. (auth)

29372 IS-503 EFFECT OF OXYGEN ON MECHANICAL PROPERTIES OF NIOBIUM. Edwin Paul Neubauer and H. A. Wilhelm (Ames Lab., Ames, Iowa). May 1962. Contract W-7405-eng-82. 63p.

The effects of oxygen on the mechanical properties of Nb were studied over the composition range 20 to 2400 ppm oxygen. Tensile properties were studied from room temperature to 500°C, and hardness values were obtained at room temperature. Oxygen additions to high purity Nb increased both the yield and tensile strengths at all temperatures investigated. As the temperature was increased above 250°C, the effect of the first 200 ppm of oxygen had more influence than further additions on the strengths of Nb. Strain aging behavior was also observed. A composition dependent mechanism, which can account for the occurrence of serrations at room temperature, is proposed. (P.C.H.)

29373 (MCW-1460) RECRYSTALLIZATION OF BETA-HEAT-TREATED DINGOT-URANIUM CORES. Topical Report. R. R. Guyer and N. F. Neumann (Mallinckrodt Chemical Works, Uranium Div., Weldon Spring, Mo.). Aug. 24, 1962. Contract W-14-108-Eng-8. 25p.

Annealing beta-heat-treated production-size dingot-uranium core blanks in the high alpha range (1150 to 1200°F) produced a fine, equiaxed grain size by a recrystallization process. The extent of recrystallization is dependent upon the rate of cooling through the beta-to-alpha transformation, the time and temperature of annealing, and whether or not impurities that retard grain growth are present. The cooling rate through the beta-to-alpha transformation was varied by using a range of beta temperatures and air cooling times prior to quenching into water. Longer air cooling times are permissible at the higher beta temperatures; however, the greatest amount of induced lattice strain was obtained after an air delay of only 2 seconds before quenching. Decreasing the annealing temperature results in a corresponding increase in the annealing time required for an equivalent amount of recrystallization. A second phase, present in the alloyed dingot metal, inhibited recrystallization and grain growth. Alloyed metal recrystallized progressively from the outer periphery to the center of the core, whereas unalloyed metal subjected to identical annealing conditions exhibited recrystallized grains throughout the cross section. A reduction in grain size from 0.38 mm to 0.25 mm occurred in a beta-treated, unalloyed core after annealing at 1200°F for 4 hours. The grain size of beta-quenched, alloyed metal decreased from 0.28 mm to 0.19 mm on recrystallization. There appears to be change in the orientation of a beta-quenched core as a result of recrystallization. The beta quench-alpha anneal process could be integrated with an alpha-phase vacuum outgassing process to produce fine-grained metal that is essentially free of strain and preferred orientation and has a low hydrogen content. (auth)

29374 (NASA-TN-D-1221) INFLUENCE OF CERTAIN COMPOSITION AND FABRICATION VARIABLES ON THE STRESS-RUPTURE PROPERTIES OF A COBALT-BASE

ALLOY CONSOLIDATED BY POWDER METALLURGY. Philip A. Clarkin, John W. Weeton, and Paul F. Sikora (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1962. 86p.

An investigation was conducted to determine the effect of carbon content and type and distribution of carbide on the stress-rupture properties and on the forgeability of an S-816 powder-metallurgy alloy. Liquid-state-sintering techniques, as well as heat treatments and mechanical working, were used to control the carbide formations and distributions. The majority of specimens produced had stress-rupture lives longer than that of standard wrought S-816 under the same test conditions. Highly forgeable structures were produced in specimens containing both high and low carbon contents. Stress-rupture lives increased with increasing carbon content. (auth)

29375 (NMI-2106) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report to United States Atomic Energy Commission, April 1962. (Nuclear Metals, Inc., Concord, Mass.). July 23, 1962. Contract AT(30-1)-2784. 18p.

Activities in an investigation of refractory metal alloys aimed at relating their high-temperature properties to features of their phase diagrams, microstructures, and thermal histories are reported. Selected compositions from binary systems containing Hf, Os, Re, and Ru are being investigated. During the report period, ingots of unalloyed Nb, unalloyed Ta, Mo-10 at. % Hf, and W-5 at. % Ru were prepared and extruded. A summary of extrusion data is included. The unalloyed Nb and Ta extruded at 1850°, and extrusions of Mo-10 at. % Hf were successful at 2000°. Extrusions of the W-5 at. % Ru failed to produce material for mechanical testing. The extruded refractory materials were evaluated by tensile tests at 1200, 1400, and 1600°C and hot hardness measurements at 300, 500, and 800°C. (J.R.D.)

29376 (NMI-9237) REFRACTORY METAL CONSTITUTION DIAGRAMS. PART II. Period Covered: April 1960 to December 1961. E. J. Rapperport, M. F. Smith, J. Wulff, J. Brophy, N. J. Grant, B. C. Giessen, A. Taylor, and N. Doyle (Nuclear Metals, Inc., Concord, Mass.). Mar. 1962. Contract AF33(616)-7157. 202p. (ASD-TR-60-132 (Pt.II))

Data on six binary constitution diagrams and two ternary constitution diagrams of some of the refractory metals are presented. The binary diagrams include Mo-Os, Ta-Ir, Ta-Rh, Ta-Zr, W-Ir, and W-Rh; the ternaries are Mo-Hf-Re and Ta-W-Zr. Care was taken to obtain reliable diagrams. In particular the purity of the constituents (99.9%+) was protected at all times, and the temperatures were measured to an accuracy of ±20°C. (auth)

29377 (NP-11997) SYNTHESIS AND STRUCTURE OF NEW HIGH PRESSURE POLYMORPHS OF RARE-EARTH VANADATES AND ARSENATES. Technical Report No. 14. Vladimir Stubican and Rustum Roy (Pennsylvania State Univ., University Park. Coll. of Mineral Industries). June 30, 1962. Contract Nonr-656(20). 19p.

A series of rare earth phosphates, arsenates, vanadates, and tantalates were reacted at pressures up to 80,000 atm and 600°C. The structures of the resulting products were evaluated by powder x-ray diffractometry. The majority of the arsenates and vanadates (Pr-Lu) undergo a reconstructive transformation from either the monazite or the xenotime (zircon) structure to the scheelite structure. Not a single instance of the xenotime ⇌ monazite reaction was observed. Equilibrium p-t curves were determined for most of these transitions. (auth)

29378 (ORNL-3339) DIFFUSION OF Zr^{95} IN BODY-CENTERED CUBIC IODIDE ZIRCONIUM. T. S. Lundy and J. I. Federer (Oak Ridge National Lab., Tenn.). Sept. 5, 1962. Contract W-7405-eng-26. 26p.

Chemically purified Zr^{95} was used in determining self-diffusion coefficients in the body-centered cubic phase of iodide zirconium over the temperature range of 900 to 1750°C. In order to minimize effects of build-in of the daughter isotope Nb^{95}, all heat treatments were completed within 48 hr after the purification. The temperature dependence of the diffusion coefficients could not be described by the usual Arrhenius-type equation. Instead, apparent values of the frequency factor D_0 and the activation energy Q varied from 4.8×10^{-6} to 2.5×10^{-2} cm^2/sec and 20700 to 46900 cal/mole, respectively, between the lower and upper extremities of the temperature range. Empirical treatment of the data indicated that Q is a linear function of temperature and that D_0 varies with a power of the temperature. The data may be described in terms of the α to β transition temperature of 1136°K and the absolute temperature of the heat treatments by the following equation: $D = 3 \times 10^{-6} (T/1136)^{15.6} \exp(-19600 + 31(T - 1136)/RT)$ cm^2/sec. (auth)

29379 (RADC-TDR-62-66) CERAMIC-METAL SEALS FOR HIGH-POWER TUBES. Second Technical Note, July 10, 1961–November 30, 1961. K. H. Styhr and A. S. Ferello (Sperry Gyroscope Co. Electronic Tube Div., Great Neck, N. Y.). Nov. 1961. Contract AF30(602)-2371. 44p. (NA-8250-8268-2)

Ceramic specimens were received; all tooling, equipment construction, and modifications completed; and the Phase I reliability study started. A non-pumping, cold cathode ionization gage for use as a life test vehicle is described and is being fabricated for testing. Preliminary metallographic data on methods of detection of hermetic leak paths are presented. Decomposition of impregnated carbonaceous materials and metals deposited from a gaseous phase are described as useful methods of leak path determination. (auth)

29380 (TID-6155) THE EFFECT OF COMPOSITION AND HEAT TREATMENT ON THE TENSILE PROPERTIES OF SOME ZIRCONIUM BASE ALLOYS. F. W. Kunz and D. L. Douglass (Knolls Atomic Power Lab., Schenectady, N. Y.). June 21, 1960. Contract W-31-109-eng-52. 45p.

The effect of composition and heat treatment on the room and elevated temperature tensile properties of some zirconium base alloys containing Nb, Sn, and Cr was determined and the strength properties of the alloys are explained on the basis of their microstructure. The microstructure, which provided the superior strength properties consisted of primary alpha and transformed beta (alpha prime). A number of the alloys showed excellent response to heat treatment, resulting in improved strength over alloys in the annealed and equilibrated condition. (auth)

29381 (TID-11173) DISPERSION STRENGTHENING OF MOLYBDENUM AT HIGH TEMPERATURES. W. V. Green and T. J. Ready (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-Eng-36]. 3p.

Dispersion-type molybdenum alloys, which contained up to 30 vol % UO_2 as the strengthening agent, were prepared. Creep test specimens were machined from the test stock, which was produced by powder metallurgy methods. The creep properties of the alloys were compared to commercially manufactured powder-metallurgy molybdenum and to the predicted creep properties of dispersion strengthened and weakened alloys. It was concluded that the creep strength of Mo is increased when UO_2 is dispersed through-

out the metal as a second phase. The shape of the creep curves and the stress dependence of the creep rate agree with the predicted properties for UO_2 dispersion strengthened Mo. (P.C.H.)

29382 (TID-11526) METALLOGRAPHIC CHARACTERISTICS OF OXIDES, NITRIDES, AND CARBIDES IN ALPHA TANTALUM. Robert W. Anderson (Los Alamos Scientific Lab., N. Mex.). [1959]. Contract [W-7405-Eng-36]. 6p.

Tantalum, with controlled additions of oxygen, nitrogen, and carbon, was studied metallographically to determine the characteristics of the resulting compounds in alpha tantalum. It is shown that the characteristics of the resulting compounds are dependent on the temperature at which they are formed. (auth)

29383 (TID-12660) ORDER AND MICROPHASES IN CeCd ~4.5 SOLID SOLUTIONS. Guy R. B. Elliott and Joe Fred Lemons (Los Alamos Scientific Lab., N. Mex.). [1960]. Contract [W-7405-Eng-36]. 23p. (LADC-4707).

A large number of phases (microphases) near the composition CeCd ~4.5 were detected by vapor pressure measurements. Family similarities exist in the activity coefficients of the microphases and in the two-phase regions between them. The two-phase ranges in some cases cover as little as 125 ppm addition of cadmium to the alloy. It is postulated that ordering of the atoms in excess of simple stoichiometry causes the microphases; the new order aligns formerly random regions of different potential and lowers the energy of the conduction electrons. Certain orders are preferred and lead to the family relationships. Models consistent with the postulates are in agreement with the kinetics and thermodynamics observed. (auth)

29384 (TID-14983) AN EVALUATION OF THE ROLE OF DEFORMATION TWINNING IN THE PLASTIC DEFORMATION OF ZIRCONIUM. Second Quarterly Progress Report. R. E. Reed-Hill (Florida. Univ., Gainesville. Engineering and Industrial Experimental Station). Jan. 1962. Contract AT(38-1)-252. 43p.

Twinning during tensile deformation and tensile creep was investigated using specimens cut from plate stock of zirconium and Zircaloy-2. It was observed that twinning during tensile deformation depends strongly on individual grain orientations. Specimens with axes parallel to the rolling direction deform almost exclusively by slip, while specimens with axes normal to the rolling direction deform both by slip and twinning. In both alloy and pure metal macroscopic plastic flow does not occur in transverse specimens until twinning is initiated. Measurements on transverse pure zirconium specimens show that the volume fraction of twinned material varies directly with the tensile strain to strains of the order of 10%. The contribution of the twinning shear to the tensile strain in these specimens is of the order of 15%, indicating that most of the deformation is accomplished by slip. Twinning during tensile deformation was observed to be by $\{10\bar{1}2\}$ in Zircaloy-2 and $\{10\bar{1}2\}$ and $\{11\bar{2}1\}$ in pure zirconium. When adjoining grains have nearly the same orientation, cooperative twinning may occur in which a chain of connected twins develops which passes through many grains. Room temperature creep tests on Zircaloy-2 indicate that transverse specimens may creep at a rate an order of magnitude greater than longitudinal specimens. (auth)

29385 (TID-16372) ON ENHANCED-DIFFUSION IN METALS DURING PLASTIC DEFORMATION. R. W. Balluffi (Illinois. Univ., Urbana) and A. L. Ruoff (Cornell Univ., Ithaca, N. Y.). [1962]. Contract AT(30-1)-2504. 14p.

Conclusions concerning the effects of point defect production during metal deformation and of rapid diffusion along dislocations and grain boundaries during deformation are presented. Conclusions reached as the result of analyses of crack and interface roughening effects and enhanced-diffusion data are also included. (J.R.D.)

29386 (UCRL-6410) A FRESH LOOK AT THE PROBLEMS IN BERYLLIUM METALLURGY. Rointan F. Bunshah (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 31, 1961. Contract W-7405-eng-48. 21p.

The current status of beryllium metallurgy is reviewed. The nonsystematic variation in the mechanical properties, particularly the low room temperature and the ductility minimum around 600°C, are its most disturbing features. Recent work shows that the 600°C ductility minimum can be eliminated by overaging of controlled compositions, which means that commercial beryllium may be considered as a complex, unstable age-hardening alloy rather than as a somewhat impure dilute alloy. The implications of this on the room temperature properties are discussed. Some comments on the technological problems and analytical requirements are made. (auth)

29387 (WADD-TR-61-72(Vol.VII)) RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME VII. HIGH DENSITY RECRYSTALLIZED GRAPHITE BY HOT FORMING. E. A. Neel, A. A. Kellar, and J. J. Zeitsch (National Carbon Co., Lawrenceburg, Tenn.). Sept. 1961. Contract AF33(616)-6915. 70p.

The mechanical and thermal properties of several types of ZT graphite are described. Grade ZTA is discussed in detail and its physical properties are compared to those of other premium graphites, including pyrolytic, over the range from room temperature to 3000°C. Specifications for Grade ZTA are established. The properties of other grades of ZT graphite and the results from 79 sub-scale firings in solid fuel rocket motors at various locations are tabulated. (auth)

29388 (WAPD-248) THE EFFECTS OF HEAT TREATMENTS ON THE HARDNESS AND TENSILE PROPERTIES OF COLD ROLLED IODIDE HAFNIUM. J. G. Goodwin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1962. Contract AT(11-1)-Gen-14. 48p.

The effects of heat treatments on the hardness and tensile properties of cold rolled hafnium are described. Equations and curves for predicting hardness after various times at temperatures of 750, 800, and 850°C (1382, 1472, and 1562°F) for cold reductions up to 25% in 5-percent increments are presented. Other curves are provided which estimate annealing times at temperatures greater than 850°C (1562°F) and up to 950°C (1742°F). The experimental data were utilized to estimate activation energies for the annealing process. Equations and curves were established to relate tensile properties to the amount of cold reduction and the testing temperature. Graphs were made of the effects of heat treatments for 0.5 or 24 hours at 700, 800, 900, 1000, and 1100°C (1292, 1472, 1652, 1832, and 2012°F) on the tensile properties at room temperature and 316°C (600°F). The data revealed a decrease in ductility as measured by percent elongation and percent reduction of area when heat treatments greater than 900°C (1652°F) were employed. No corresponding change in yield or ultimate tensile strength values was noted at these temperatures. (auth)

29389 (AEC-tr-5290) FRAGILITY OF A SOLID Al–Fe SOLUTION. Gerard Cabane, Pierre Mouturat, Pierrette

Pepin, Jean Petit, Gerard Sainfort, and Marc Salesse. Translated from Compt. rend., 254: 3360-2(May 7, 1962). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 25776.

29390 (AEC-tr-5298) OXIDES OF THE LOW TEMPERATURE OXIDATION OF NIOBIUM AND TANTALUM. G. Brauer, Horst Mueller, and G. Kuehner (Freiburg i. B. Universitat). Translated for Oak Ridge National Lab., Tenn. [nd.] 24p.

Suboxide phases of niobium and tantalum were formed by heating the metals up to 300 to 500°C in an atmosphere of air or oxygen under normal or reduced pressure. The characteristic lattice structures of the suboxides are related to those of the respective metals. These compounds appear to have metallic character. It is probable that the chemical composition of one of these suboxides corresponds to the formula $Nb_6O(Ta_6O)$. (auth)

29391 (AEC-tr-5315) THE DETECTION OF IMPURITIES AND COLDWORKING IN SINTERED TUNGSTEN BY THE MEASUREMENT OF RESIDUAL RESISTANCE. Erich Krautz and Hermann Schultz. Translated from Z. Metallk., 49: 399-403(1958). 7p.

The measurements of residual resistance at a temperature range of liquid hydrogen were performed on tungsten samples of various composition and preparation. Dissolved metallic impurities in some concentrations increased the residual resistance the more, the further they were from tungsten in the periodic table. Lattice soluble foreign metals hardly changed the increase of residual resistance in the working. A marked change in the residual resistance on addition of Al_2O_3 indicated that after dissociation at high temperatures, Al is taken into the W lattice. It is shown that the impurities in sintered tungsten rods through evaporation can develop a concentration gradient of the Al from the core to the surface section. The remaining impurity content of W depends greatly on the grain size of the metal powder. Fine-grained powders sintered at some temperatures had a considerably higher impurity content than coarse-grained powders. In sintering pure powders, the residual resistance changed in a way similar to pore volume with increasing degree of sintering. (auth)

29392 (AEC-tr-5323) THE STRUCTURE AND PROPERTIES OF NIOBIUM–TIN ALLOYS. M. I. Agafonova, V. V. Baron, and E. M. Savitskii (Savitsky). Translated for Ames Lab., Ames, Iowa from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 5, 138-41(Sept.-Oct. 1959). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 18194.

29393 (AEC-tr-5324) STUDY OF THE KIRKENDALL EFFECT AS A FUNCTION OF CONCENTRATION IN URANIUM–ZIRCONIUM DIFFUSION. Y. Adda, C. Mairy, and J. L. Andreu. Translated by Eugene E. Gruber, Jr. (Carnegie Inst. of Tech., Pittsburgh) from Mem. sci. rev. met., 57: 550-6(July 1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 23340.

29394 THE CRYSTAL STRUCTURE OF $ReBe_{22}$. Donald E. Sands, Quintin C. Johnson, Allan Zalkin, Oscar H. Krikorian, and Kurt L. Kromholtz (Univ. of California, Livermore). Acta Cryst., 15: 832-4(Sept. 10, 1962). (UCRL-6560)

$ReBe_{22}$ is face-centered cubic with a = 11.561 Å; there are eight formula units per unit cell and the space group is Fd3m. Each Re atom has 16 Be neighbors at 2.50 to 2.53 Å. There are 4 types of Be atoms: Be_1 has 2 Re neighbors at 2.50 Å and 12 Be neighbors at 2.46 Å; Be_2 and Be_3 each have 12 Be neighbors at 2.05 to 2.29 Å; Be_4 has 1 Re neighbor at 2.53 Å and 11 Be neighbors at 2.13 to 2.46 Å. (auth)

29395 STRUCTURAL FEATURES OF SOME PHASES RELATED TO CEMENTITE. B. Aronsson and S. Rundqvist (Univ. of Uppsala). Acta Cryst., 15: 878-87(Sept. 10, 1962).

Investigations during the last few years have shown that a number of phases, especially borides, of the seventh and eighth group metals are isomorphous with cementite or crystallize in structures closely related to that of cementite. In this paper the recently obtained structural data are summarized and discussed. The influence of the radius ratio on trends in interatomic distances and lattice parameters is particularly considered. On basis of the presented data some general remarks on "complicated" interstitial phases are also made. (auth)

29396 IRRADIATION PINNING AND THERMAL DEPINNING OF DISLOCATIONS. A. Sosin (Atomics International, Canoga Park, Calif.). Acta Met., 10: 390-6(Apr. 1962).

Elastic moduli and internal friction measurements were made in pure annealed copper prior to and after high-energy electron irradiation and selected thermal treatment. Both the dislocation pinning effects which occur upon irradiating or upon subsequent heating to less than about 140°C, and the depinning effects which occur upon subsequent heating above this temperature, are observed to be complex; a model which attributes these effects to pinning of one type of dislocation by point defects is inadequate. Furthermore, a tight binding of point defects by dislocations, with no essential loss in identity of the point defects, appears to be implied by the observation that full depinning does not occur below about 550°C. (auth)

29397 INTERNAL FRICTION PEAKS IN COLD-WORKED METALS. R. R. Hasiguti (Tokyo Univ.), N. Igata, and G. Kamoshita. Acta Met., 10: 442-7(Apr. 1962).

Internal friction peaks which appear after cold-working were investigated in ten metals including copper, silver, aluminum, nickel, titanium, zirconium, magnesium, cobalt, iron, and uranium. Two or three peaks, which disappear upon annealing at room temperature, appear in all metals. A peak which does not disappear after room temperature annealing is found in some of the ten metals. This peak is sometimes accompanied by a satellite. In the case of aluminum, this persistent peak is presumably different from the Bordoni peak. Activation energies and frequency factors were obtained from peak shifts, concerning all the peaks observed. Possible mechanisms for the processes responsible for these peaks are briefly discussed. (auth)

29398 PLASTIC BEHAVIOR IN MAGNESIUM OXIDE. H. N. Sinha (Univ. of Melbourne). Atomic Energy 5, No. 3: 16-19(July 1962).

Single and bi-crystals of MgO are subjected to bend tests and thermal shocks. The bend tests reveal that MgO is essentially ductile. Chemical polishing is found to increase the resistance of the single crystals to thermal shock, but not that of the bi-crystals. (T.F.H.)

29399 HIGH TEMPERATURE PHASE EQUILIBRIA IN THE SYSTEM CARBON–OXYGEN–URANIUM. John Richard Piazza (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 192(July 1962).

Equilibrium relationships among uranium monocarbide, uranium dicarbide, graphite, uranium dioxide, and carbon monoxide were investigated in the temperature range be-

tween 1400 and 1700°C and at pressures below one atmosphere. The two univariant equilibria $UO_2 + 4C = UC_2 + 2CO$ and $UO_2 + 3UC_2 = 4UC + 2CO$ were found to exist over the temperature range studied. Carbon monoxide equilibrium pressure as a function of temperature was determined for both equilibria. Pressure-temperature data were used to formulate analytical expressions for the carbon monoxide equilibrium pressures. The expressions were determined as $\log_{10}p_{CO} = -18000/T + 8.23$ and $\log_{10}p_{CO} = -16600/T + 7.26$ for the first and second equilibria, respectively. Experiments were made to assess the activity of the solid phases involved in the equilibria and to determine the order of magnitude of errors due to the presence of nitrogen in the system. The experiments included precision lattice parameter determinations at room temperature of the monocarbide and dioxide phases in the solid residues. The activities of the monocarbide and dicarbide were estimated as 0.95 ± 0.05 throughout the range of temperatures investigated. It was concluded from the study of the effect of nitrogen that the errors in the carbon monoxide equilibrium pressures for the first equilibria are negligible and that those for the second amount to 10% or less. Expressions for standard Gibbs free energies of reaction in calories for the reactions $UO_2 + 4C \rightarrow UC_2 + 2CO$, $UO_2 + 3UC_2 \rightarrow 4UC + 2CO$, $UO_2 + 3C \rightarrow UC + 2CO$, and $UC + C \rightarrow UC_2$, were determined as 164,500-74.23T, 152,200-65.42T, 161,400-72.03T, and 3,100-2.20T, respectively. The effects of nitrogen indicate that, at temperatures in the range studied, uranium mononitride will coform with uranium monocarbide if nitrogen is present in the gas phase. The results also indicate that lowering of the monocarbide activity stabilizes mixtures of the monocarbide and graphite with respect to the dicarbide. The extent to which the monocarbide activity need be lowered to equilibrate graphite, the monocarbide and the dicarbide is indicated by the free energy of reaction for $UC + C \rightarrow UC_2$ given by 3100-2.20T calories. (auth)

29400 SCANDIUM CARBIDES AND COMPOUND SCANDIUM–TITANIUM CARBIDES. G. V. Samsonov, G. N. Makarenko, and T. Ya. Kosolapova (Inst. of Metal-Ceramics and of Special Alloys, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 1062-5(1962). (In Russian)

The location of Sc in the periodic table next to Ti which forms very hard carbides and at the head of Subgroup IIIA made it probable that its carbides present technological interest in view of their relation to Ti and to rare earths. The carbides were prepared on the basis of the following reactions: $Sc_2O_3 + 5C = 2ScC + 3CO$; $Sc_2O_3 + 6C = 2Sc_2C_3 + 3CO$; $Sc_2O_3 + 7C = 2ScC_2 + 3CO$, heating the carbides under vacuum while removing continuously the gaseous reaction products. The reaction yielding the monocarbide starts at 1300 to 1400°C but the theoretical 21.08% of bound C is reached only at 1900°C. At still higher temperatures it is assumed that Sc_2O_3 or ScO_2 is formed; metallic Sc is probably also formed as an intermediary product. ScC forms a NaCl type, face-centered crystal lattice with a = 4.53. The material has the ability of forming isomorphous carbides. This was verified by the simultaneous reduction of $Sc_2O_3 + TiO_2$ with C in vacuum. The hardness of the specimens reached 5000 kg/mm², considerably higher than the 3000 kg/mm² of pure TiC. The solubility region of the solid solutions is higher for ScC in TiC than for TiC in ScC. It is expected that ScC will find use in increasing the hardness of the carbides of the other transition metals. (TTT)

29401 A METALLOGRAPHIC TECHNIQUE FOR REVEALING AND OBSERVING DISLOCATION ETCH PITS IN 18-8 TYPE STAINLESS STEEL. A. Bassi (Laboratori CISE, Segrate, Milan), G. Camonia, G. Dassu, and G. Piazzesi. Energia nucleare (Milan), 9: 333-48(June 1962). (In English)

A metallographic technique for the production of dislocation etch pits in 18/8 type stainless steel is described. The technique is easily reproducible and may make a promising control and research method. The average density of the dislocation etch pits revealed is in agreement with results obtained in a different way by other research workers. (auth)

29402 PHASE EQUILIBRIUM STUDIES IN THE SYSTEM IRON OXIDE-Y_2O_3-Gd_2O_3. H. Jerrold Van Hook (Raytheon Co., Waltham, Mass.). J. Am. Ceram. Soc., 45: 369-73(Aug. 1962).

Equilibrium data at liquidus temperatures are presented for compositions in the quaternary system Y-Gd-Fe-O in ambient atmospheres of oxygen gas (p_{O_2} = 760 mm Hg), air (p_{O_2} = 159 mm Hg), and CO_2 (p_{O_2} variable). Incongruent melting occurred in yttrium-iron and gadolinium-iron garnet phases and in all intermediate garnet solid solutions in the three oxygen pressure sections studied. Fractionation in the yttrium/gadolinium ratio between oxide liquid and crystalline garnet phases in the quaternary system was not observed experimentally, indicating that unzoned $(Y,Gd)_3Fe_5O_{12}$ crystals may be grown from a melt without special precautions to maintain a fixed Y/Gd ratio. (auth)

29403 FORMATION OF CUBIC ZrO_2 WITH TRANSITION METALS OF GROUPS V AND VI AND THEIR OXIDES. Michael Hoch and Mool-Raj Mathur (Univ. of Cincinnati). J. Am. Ceram. Soc., 45: 373-5(Aug. 1962).

Cubic ZrO_2 can be formed at 1500°C from tetragonal ZrO_2 and transition metals of groups V and VI or their monoxides only in the presence of TiO_2. The 1500° isotherm of the pseudo-ternary system ZrO_2-TiO_2-VO was investigated and the extent of the single-phase cubic ZrO_2 region was determined. In the system Ta-Ta_2O_5 the lower oxides cannot be formed by reacting Ta and Ta_2O_5 between 1450° and 1815°C. (auth)

29404 PHASE RELATIONS AND ELECTRICAL PARAMETERS IN THE FERROELECTRIC-ANTIFERROELECTRIC REGION OF THE SYSTEM $PbZrO_3$-$PbTiO_3$-$PbNb_2O_6$. R. H. Dungan, H. M. Barnett, and A. H. Stark (Sandia Corp., Albuquerque, N. Mex.). J. Am. Ceram. Soc., 45: 382-8 (Aug. 1962).

Characteristics of temperature and field-induced ferroelectric-antiferroelectric phase transitions are reported as a function of composition. The ferroelectric compositions were found to exhibit remanent polarizations of the order of 30 μcoulomb per cm², coupled with low dielectric constants and piezoelectric response. Evidence is presented for the existence of a polymorphic transition in the ferroelectric rhombohedral region of the system $PbZrO_3$-$PbTiO_3$ and the existing phase diagram modified accordingly. (auth)

29405 SYNTHESIS AND SUPERCONDUCTING PROPERTIES OF Nb_3Sn_2 AND Nb_2Sn_3. Thomas B. Reed and Harry C. Gatos (Massachusetts Inst. of Tech., Cambridge). J. Appl. Phys., 33: 2657(Aug. 1962).

Nb_3Sn_2 and Nb_2Sn_3 are produced by the vacuum heating of powders having the proper stoichiometric proportions at about 500 to 875°C. Both have tetragonal structure; the former exhibits a superconducting transition at 16.6°K, and the latter exhibits no sharp transition above about 5°K. (T.F.H.)

29406 COMPRESSIBILITY OF LIQUID SODIUM–POTASSIUM ALLOYS. G. Abowitz and R. B. Gordon (Yale

Univ., New Haven). J. Chem. Phys., 37: 125-8(July 1, 1962).

The velocity of sound was measured in the sodium–potassium alloy system as a function of both composition and temperature. For each composition the velocity was found to be a linear function of the temperature. The behavior of the compressibility, because of the volume contraction on alloying, cannot be explained in terms of a free electron model. A possible explanation is that changes in the electronic charge density upon alloying give rise to the volume contraction and the slight positive deviation in the compressibility. (auth)

29407 VAPORIZATION OF RUTHENIUM AND OSMIUM. Morton B. Panish and Liane Reif (Avco Corp., Wilmington, Mass.). J. Chem. Phys., 37: 128-31(July 1, 1962).

The vapor pressures of ruthenium and osmium were determined by the use of Langmuir vaporization and Knudsen effusion techniques. The vapor pressure of ruthenium over the temperature range 2000 to 2500°K is represented by the equation $\log p_{(mm)} = 10.81 - 33480/T$, and the vapor pressure of osmium over the temperature range of from 2300 to 2800°K by the equation $\log p_{(mm)} = 10.85 - 40950/T$. Third-law analyses of the data yield the following heats of vaporization: ruthenium $\Delta H^{\circ}_{298} = 154.9 \pm 1.3$ kcal/mole; osmium $\Delta H^{\circ}_{298} = 187.4 \pm 0.9$ kcal/mole. Estimated boiling points for ruthenium and osmium are 4350 ± 100°K and 5300 ± 100°K, respectively. (auth)

29408 VAPORIZATION BEHAVIOR OF NIOBIUM CARBIDE. R. J. Fries (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 37: 320-7(July 15, 1962).

The vaporization behavior of niobium carbide was studied over the temperature range from 2260 to 2940°K utilizing the Langmuir method. NbC was observed to lose carbon preferentially down to a composition of $NbC_{0.75}$, at which composition the vaporization proceeds congruently at a temperature of 2940°K. The vapor pressure of carbon above nearly stoichiometric NbC could be represented by the equation $\log P\,(atm) = 5.296 - 3.276 \times 10^4/T$ with a corresponding second law heat of vaporization of 150 kcal/mole of C vaporized. However, third law calculations and heat of formation data indicate a ΔH°_{298} of from 180 to 189 kcal/mole. Several possible explanations of this disagreement are discussed. The total rate of evaporation from NbC_x was found to increase by a factor of two as the value of x decreased from 0.97 to 0.80. Finally, a semi-quantitative evaluation of the diffusion constant of C in NbC was made, resulting in a value of $D \cong 8 \times 10^{-7}$ cm²/sec at 2940°K. (auth)

29409 PHASE DIAGRAMS OF TITANIUM ALLOYS WITH RARE EARTH METALS. E. M. Savitskii and G. S. Burkhanov (Inst. of Metallurgy, Academy of Science, Moscow). J. Less-Common Metals, 4: 301-14(Aug. 1962). (In German)

An account is given of the results of an investigation of the phase diagrams of titanium alloys with rare-earth metals. All rare-earth metals when alloyed with titanium form the same type of phase diagram. This confirms that the type of phase diagram and the characteristics of the physical-chemical reciprocal effect of the components are determined primarily by the characteristics of their electron structure. The rare-earth metals prove to be stabilizers for the α-phase of titanium and raise slightly the temperature of the polymorphic transformation of titanium. In conformity with the lanthanide contraction the solubility of the rare-earth metals in titanium increases in the sequence La to Lu. In rare-earth metal–titanium systems no intermetallic bonds are formed despite the significant difference in the electronegativity of the components. There are many transition metals with which the rare-earth metals do not form intermetallic bonds, the transition metals of Group VIII of Mendeléeff's Periodic System being an exception to this. The electronegativity factor restricts considerably the mutual solubility of the alloy components. Of all the systems considered it is especially noticeable in the titanium–scandium system that, apart from the favorable structure and volume factor, a fairly limited mutual solubility of the components exists. The presence of aluminum and vanadium in titanium decreases considerably the solubility of cerium and lanthanum in titanium. (auth)

29410 THE METALLURGY OF SCANDIUM. Doyle Geiselman (Union Carbide Corp., Niagara Falls, N. Y.). J. Less-Common Metals, 4: 362-75(Aug. 1962). (In English)

Crystal structure, density, electrical resistivity, thermoelectric power, and thermal expansion of scandium were measured. Also measured were hardness, modulus of elasticity, tensile strength, and compressive strength. The resistance to chemical corrosion and reaction with air, nitrogen, and oxygen were determined. A similar but more limited study was made on scandium–titanium alloys containing up to 11.35% titanium. The general conclusion was that scandium behaved more like yttrium than aluminum or titanium. Metallographic techniques are also described. (auth)

29411 EXPLORING THE TRANSFORMATION BEHAVIOUR OF THE ALLOTROPES OF PLUTONIUM. J. D. Hill (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 4: 376-86(Aug. 1962). (In English)

The hysteresis between temperatures of transformation on heating and cooling in the lower three allotropic transformations of plutonium is due to an unusual sluggishness of the transformation mechanism, which is reflected in various ways in the individual transformations. A study of this sluggishness gives 112 ± 1°C and 184 ± 2°C for the equilibrium temperature of the $\alpha \rightleftharpoons \beta$ and $\beta \rightleftharpoons \gamma$ transformations respectively. Impurities in plutonium increase the time constant of the transformation mechanism still further. This is a possible source of error in using alloy constitution diagrams obtained by the usual methods as sources of thermodynamic data. Experimental evidence suggests that the latent heat of the $\delta \rightarrow \delta'$ transformation is about 100 cal/g-atom, in disagreement with previous results. The "maximum rates" results used to find the $\alpha \rightleftharpoons \beta$ and $\beta \rightleftharpoons \gamma$ equilibrium temperatures show more scatter than that expected from the intrinsic error of the measuring system. An effect at about 280°C, observed while investigating possible causes for this scatter, may have a bearing on the "elbow" effect noticed in the $\delta \rightarrow \gamma$ transformation by several workers. (auth)

29412 THE EFFECT OF ELECTRONEGATIVITY ON SOLID AND LIQUID MISCIBILITY. W. Hume-Rothery (Oxford Univ.). J. Less-Common Metals, 4: 390-2(Aug. 1962). (In English)

The fact that Yb and Th exhibit very limited mutual solid and liquid miscibilities was interpreted in terms of a rule involving an electronegativity vs radius (for coordination number 12) graph. In this rule, an ellipse is drawn around one element on the graph, and the elements within the ellipse are predicted to form extensive solid solutions with this element, while the other elements lying outside the ellipse have limited solubilities. Numerous exceptions to the rule are given with Au, Ag, Cu, and Mg as solvent, and

the justification of the rule is doubtful. Some of the reasons for the exceptions are discussed. It is concluded that an extreme difference in electronegativity (e.g., Au-Mg, Au-In, Ag-Li) does not preclude the formation of extensive solid solutions. (D.L.C.)

29413 ON DIFFERENT PROCESSES OF RECRYSTALLIZATION IN BERYLLIUM. C. Gasc and M. Baudeau (Laboratoire de Metallurgie Physique de la Faculte des Sciences, Poitiers, France). J. Nuclear Materials, 6: 120-2(May–June 1962). (In French)

A brief résumé is given of results obtained on the recrystallization of Be. The metal was worked by cutting and by compression at 400°C. A microscopic study showed four processes permitting the metal to lose its worked structure: induced growth, classic germination, polygonization, and germination from twins. (J.S.R.)

29414 MEASUREMENT OF CRYSTAL LATTICE PARAMETERS OF URANIUM–PLUTONIUM SOLID SOLUTIONS. H. Paruz (Centre d'Etudes Nucléaires, Fontenay-aux-Roses, France). J. Nuclear Materials, 6: 127-9(May–June 1962). (In French)

Alloys containing 0.5, 10, and 15 wt % Pu were studied. The crystal parameters were determined on massive samples with a diffractometer, and the results are tabulated together with those obtained by previous workers. The curves of the variation of different crystalline parameters as a function of the Pu concentration have the same shape as those of the variation of these same parameters as a function of temperature. The studies indicate that the solubility limit of Pu in α-U at room temperature is between 10 and 15 wt % Pu. (J.S.R.)

29415 STUDY OF SELF-DIFFUSION IN α PHASE URANIUM. Y. Adda and A. Kirianenko (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 6: 130-4(May–June 1962). (In French)

The self-diffusion of U was studied at temperatures between 580 and 650°C in polycrystalline samples. An autoradiographic study of sections parallel to the diffusion interface indicates the self-diffusion within the volume is accompanied by a self-diffusion at grain boundaries at temperatures below 600°C and that the diffusion anisotropy is probably very low. The activation energy for the self-diffusion, measured as 40 kcal/at. g, does not seem to be effected by the intragranular self-diffusion. The low anisotropy probably excludes the growth mechanisms under irradiation based on an anisotropic diffusion of holes. (J.S.R.)

29416 REDUCTION OF SELF-DIFFUSION COEFFICIENTS IN γ PHASE OF URANIUM BY ADDITIONS OF MOLYBDENUM, ZIRCONIUM OR NIOBIUM. Y. Adda and A. Kirianenko (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 6: 135-6(May–June 1962). (In French)

The self-diffusion of U in alloys containing 10 at. % Mo, Nb, or Zr was studied. The coefficient of diffusion was calculated and compared with the self-diffusion coefficient of pure U. As the logarithm of this coefficient varies linearly as a function of the absolute temperature, the values of the activation energy and the frequency factor corresponding to the self-diffusion were calculated. The results show that Mo and Nb, additions which retard the self-diffusion of γ-U, are capable of improving the behavior of γ-U under irradiation. (J.S.R.)

29417 MORPHOLOGY OF A LIQUID PHASE ALUMINUM BASE IN INTERFACES AND GRAINS OF BERYLLIUM. G. Donze, D. Dutilloy, R. Le Hazif, and Y. Adda (Centre d'Etudes Nucléaires, Saclay, France). J. Nuclear Materials, 6: 137-8(May–June 1962). (In French)

The morphology of a liquid phase placed at the grain boundaries depends on the value of the ratio σ_1/σ_j of the surface energy of the solid-liquid interface to that of the grain boundary. Be–Al alloys with 10% Al and Be–Al–M alloys (M being Fe, Ni, Cu, and Si) with 10% Al and 3% M were prepared. In the Be–Al alloy the angle of contact between the liquid and solid is very low for temperatures between 700 and 1000°C. The Be concentration in the liquid phase varies with the temperature. In the ternary alloys, Fe, Ni, and Cu increase the value of σ_1, and the liquid phase is collected into isolated accumulations. On the contrary Si reduces the value of σ_1 so that the liquid phase wets the grain boundaries. (J.S.R.)

29418 THE EFFECT OF ANNEALING ON THE STRUCTURE AND MECHANICAL PROPERTIES OF SAP. D. Buttinelli (Universitá Rome) and G. de Gregorio. Met. ital., 54: 125-30(Apr. 1962). (In Italian)

The results of an experimental study on the effect of long annealing at 500 and 600°C on the mechanical and structural properties of sintered aluminum powder in the form of both rolled and extruded sections are reported. The data obtained show the good behavior of extrusions and indicate some structure changes accompanied by a marked embrittlement occurring in rolled SAP sections with a higher oxide content (SAP, 89.5%; oxide, 10.5%). It was possible to outline the areas of utilization of various SAP products and to indicate those which are most suitable for high temperature use. (auth)

29419 METALLIC MOLYBDENUM. I. UNALLOYED MOLYBDENUM. Mont. H. Braun (Climax Molybdan Gesellschaft, Zurich). Metall, 16: 646-55(July 1962). (In German)

Mo, a high-melting and high-temperature resistant good conducting metal, is being used increasingly as a pure metal. Its important properties are described in detail and its preparation is briefly explained. Purification of the metal presents no special problems when some precautions concerning its mechanical behavior at room temperature and its oxidation susceptibility are considered. (tr-auth)

29420 LATEST RESULTS ON THE DEFORMATION BEHAVIOR OF THE METALS NIOBIUM, TANTALUM, MOLYBDENUM, AND TUNGSTEN AT LOW AND MODERATE TEMPERATURES. F. Ostermann (Aeronautical Systems Div., Wright-Patterson AFB, Ohio). Metall, 16: 656-61(July 1962). (In German)

A bibliographic review is made of the latest studies on the deformation behavior of Nb, Ta, Mo, and W at low and moderate temperatures. The topics discussed are physical properties, deformation properties, yield point, hardening, and the effect of temperature on the yield stress. 88 references. (J.S.R.)

29421 THE STABILITY OF CERAMICS WITH RESPECT TO GASES. II. REVISION OF KNOWN DATA. H. J. Booss. Metall, 16: 668-71(July 1962). (In German)

Data published since 1956 on the stability of metallic oxides and carbides with respect to gases are tabulated. The metals reviewed are Si, Ti, Zr, Th, Ta, Cr, Mo, and W. The decarburization of WC, the reduction of ThO_2 by W_2C, reduction of WO_3, and the precipitation of Ti from the gaseous phase are also discussed. (J.S.R.)

29422 QUENCHING VACANCIES IN URANIUM MONOCARBIDE. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag., (8), 7: 827-30(May 1962)

Increases in electrical resistivity after quenching in thin bars of uranium monocarbide are measured and interpreted in terms of lattice vacancies. The activation energy for vacancy formation is deduced as ~2.8 ev. From annealing experiments the activation energy for movement is found to be ~1.1 ev and a vacancy makes 5×10^{10} to 10^{11} jumps during its lifetime. (auth)

29423 A THEORY OF THE ELECTRICAL PROPERTIES OF LIQUID METALS. II. POLYVALENT METALS. C. C. Bradley, T. E. Faber, E. G. Wilson, and J. M. Ziman (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8), 7: 865-87(May 1962).

The electronic properties of liquid polyvalent metals are discussed in relation to the nearly free-electron model. The observed Hall effect (including measurements on Hg, In, and Sn) is consistent in most cases with a spherical Fermi surface for the valence electrons. The optical properties fit a simple Drude formula, with the same density of states as for free electrons. The evidence from the magnetic susceptibility and its change at the melting point is only qualitative, but is consistent with a free-electron sphere in the liquid. Only the observed small change in the Knight shift on melting is difficult to interpret in the model. The electrical resistivity is assumed to be represented, in first approximation, by an integral over the angle of scattering of a conduction electron, where the integrand contains the x-ray scattering function of the liquid and the Fourier transform of a "pseudo-potential" for each ion. The formula adequately describes the data, with a pseudopotential that seems to depend systematically on the place of the element in the periodic table. This pseudo-potential appears to be smaller than the equivalent quantity in the solid, where it determines the energy gaps between electron bands. The thermoelectric power is measured for Zn, Cd, Hg, In, Sn, Pb, and Bi, and can be made to fit the theory if it is assumed that in a few metals (especially Hg) the scattering cross section of each atom depends on the energy of the electron. This dependence may also be apparent in the effect of pressure on the resistivity, which is observed to be empirically correlated with the magnitude of the thermoelectric power. Finally, it is shown that the temperature-dependence of resistivity (especially the negative coefficient in the divalent metals) can be qualitatively explained, within the framework of the nearly free-electron model, in terms of thermal expansion and changes in the x-ray scattering function. (auth)

29424 ELECTRICAL BEHAVIOR BELOW 300°K OF PLUTONIUM-RICH, DELTA-PHASE SOLID SOLUTION ALLOYS CONTAINING CERIUM, ALUMINUM AND ZINC. R. O. Elliott, C. E. Olsen, and J. Louie (Los Alamos Scientific Lab., N. Mex.). Phys. and Chem. Solids, 23: 1029-44(Aug. 1962). (In English)

Electrical resistivity measurements were made as a function of temperature below 300°K on eleven plutonium-rich, δ-phase solid solution alloys containing cerium, on seven containing aluminum, and on six containing zinc. Curves showing the isothermal variation of resistivity as a function of cerium and aluminum contents are given for various temperatures between 0 and 300°K over nearly the full ranges of alloying compositions possible. Effects of cerium, aluminum, and zinc solutes on the resistivity maximum in δ plutonium at low temperatures are discussed. The square root of ρ^* was found to vary linearly with $x(1-x)$, where ρ^* is the resistivity maximum corrected to compensate for the lattice vibration and residual terms and where x is the atomic fraction of solute. (auth)

29425 ANISOTROPIC THERMAL CONDUCTIVITY OF PYROLYTIC GRAPHITE. Glen A. Slack (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 127: 694-701(Aug. 1, 1962).

The thermal conductivity K of a bulk sample of pyrolytic graphite has been measured from 3 to 300°K both perpendicular and parallel to the c axis. Over the whole temperature range below 100°K the thermal conductivity in both directions appears to be limited by the crystallite size. The measured value of $K_{\perp}$ is 0.72 W/cm deg at 300°K, and $K_{\perp}$ decreases monotonically to 1.4×10^{-4} W/cm deg at 3°K. The measured anisotropy $K_{\perp}/K_{||}$ decreases monotonically from 47 at 300°K to 2.5 at 3°K. A theoretical calculation of the anisotropy from the elastic constants yields a value of 2.27 for $T \leq 1$°K. A suggestion is offered to explain the rapid rise in the anisotropy with increasing temperature. Previous measurements of $K_{\perp}/K_{||}$ in natural and commercial graphite samples are much smaller. (auth)

29426 EFFECT OF LOCAL ORDER ON ENERGY BANDS IN BINARY ALLOYS. R. D. Mattuck (Univ. of Copenhagen). Phys. Rev., 127: 738-43(Aug. 1, 1962).

Equations are developed giving the dependence of the energy band shape on the state of local and long-range order in an alloy. The approximation used is the "empty-lattice virtual crystal" model, in which a free electron gas is perturbed by a fluctuating potential of zero average value. The energy correction is expressed in terms of the nearest-neighbor order parameter α and long-range parameter λ; this is done with the aid of a qualitative formula giving nonnearest-neighbor parameters as functions of α. The result is evaluated numerically, and it is shown how the band bottom gets squeezed out into a long tail as α proceeds from the perfect short-range order → random → clustered cases. The effect of long-range order is discussed and the conclusions are compared with those of a previous tight-binding calculation. (auth)

29427 CORRELATION BETWEEN THE ELECTRON GAS BULK MODULUS AND $c_{12}-c_{44}$ OF MONOVALENT METALS. W. C. Overton, Jr. (U. S. Naval Research Lab., Washington, D. C.). Phys. Rev., 127: 1107-9(Aug. 15, 1962).

When the shear elastic constants of the monovalent metals are assumed to be due to central forces, the deviation from the Cauchy relations of elasticity can be attributed to the bulk modulus of the electron gas. This modulus may be calculated from the total gas energy using the exchange and correlation contributions due to Gell-Mann and Brueckner (GB) and to Fletcher and Larson (FL). The bulk modulus of Cu based on the FL energies is found to agree quantitatively with the experimental $c_{12}-c_{44}$ and to have also the correct volume dependence from 0 to 300°K. The bulk modulus of the Na gas at 300°K based on the exchange and correlation energies of GB agrees within 6% with $c_{12}-c_{44}$ observed. Comparisons are also made for Ag but no agreement is found. These correlations seem inconsistent in that the same formula should work for both Cu and Na if there are central forces, and the GB result should work for neither because it is supposed to be invalid in the range of real metallic densities. The correlations provide no final criteria for the determination of the proper exchange and correlation energies of the electron gas. (auth)

29428 LINEAR RATE OF RECRYSTALLIZATION CENTRE GROWTH IN NIOBIUM. E. E. Zasimchuk and L. N. Larikov. Ukrain. Fiz. Zhur., 7: 202-4(1962). (In Ukranian)

A roentgenographic study was made of the temperature dependence of the linear rate of growth of recrystallization centers G in 99.997% pure Nb, deformed by 94% by uniaxial compression at room temperature. The microstructure of

partially recrystallized Nb and the experimentally obtained values of G at various temperatures are given. The temperature dependence of G is described by the equation $G = 10^{16} \exp(-130{,}000 \pm 10{,}000)/RT$ cm/sec. Large values of G_0 and Q_G are due to the presence of small impurities delaying recrystallization. (auth)

29429 THE MAGNETIC MOMENT OF THE 5⁻ LEVELS OF Sn^{118} AND Sn^{120}. E. Bodenstedt, H. J. Koerner, E. Gerdau, J. Radeloff, K. Auerbach, L. Mayer, and A. Roggenbuck (Universität, Hamburg). Z. Physik, 168: 370-85(1962). (In German)

The rotations of γ-γ angular correlations in strong external magnetic fields were observed in the decay of 5.1 hr Sb^{118} and 5.8 day Sb^{120}. Values of the gyromagnetic ratios of the 5⁻ two particle states of Sn^{118} and Sn^{120} were derived. In the case of 5.1 hr Sb^{118} the rotation of the 254 kev–1.221 Mev γ-γ angular correlation in a field of 40,950 Gauss was measured as $\omega_L \cdot \tau = 0.417 \pm 0.038$, and the g-factor of the 5⁻ state was derived as $g = -0.068 \pm 0.007$. This value is correct under the assumption that the rotation in the 4^+ state is negligible. The half life of this state was found to be $T_{\frac{1}{2}} \geq 7 \times 10^{-10}$ sec. In the case of 5.8 day Sb^{120} the rotation of the 200 kev–90 kev γ-γ angular correlation in a field of 53,200 Gauss was found to be $\omega_L \cdot \tau = 0.150 \pm 0.020$, and the g-factor of the 5⁻ state was derived as $g = -0.074 \pm 0.010$. The evaluation implies a small correction for the Compton background of the high energy γ transitions. It is assumed that the rotation in the 4^+ state is negligible. The half life of the 4^+ state was found to be $T_{\frac{1}{2}} \geq 6 \times 10^{-10}$ sec. The half lives of the 5⁻ states of Sn^{118} and Sn^{120} were determined as $T_{\frac{1}{2}} = (21.7 \pm 0.2) \times 10^{-9}$ sec and $T_{\frac{1}{2}} = (5.53 \pm 0.06) \times 10^{-9}$ sec respectively. Differential angular correlation measurements proved that attenuations in the 5⁻ states by internal fields were very small for the liquid sources used in these experiments. The results for the gyromagnetic ratios of the 5⁻ states are consistent with the theoretical interpretation of these levels as mainly $(h_{11/2}, s_{1/2})$ two-neutron configurations. (auth)

29430 THE PHASE DIAGRAM OF THE THREE COMPONENT SYSTEM Bi-Ca-Mg INCLUDING A CORRECTION OF THE BOUNDARY SYSTEM Bi-Ca-Mg. S. Hoesel (Universität, Halle, Ger. and Hochschule fur Maschinenbau, Karl-Marx-Stadt, Ger.). Z. physik. Chem. (Leipzig), 219: 205-23(1962). (In German)

Phase diagrams were formulated or completed by means of thermal analyses and microscopic structure studies. The system Bi-Ca-Mg was first studied by Koster and Sautter who explained the basic structure. The present investigation represents an expansion of their results. Simultaneously a considerable correction was made in the binary system Bi-Ca. (tr-auth)

29431 THE TERNARY SYSTEM MAGNESIUM-BISMUTH-TIN. M. Wobst (Universität, Halle, Ger. and Hochschule für Maschinenbau, Karl-Marx-Stadt, Ger.). Z. physik. Chem. (Leipzig), 219: 239-65(1962). (In German)

The principal results from thermal analyses and microscopic structure studies of the Mg-Bi-Sn phase diagram are reported. (tr-auth)

29432 PERFORMANCE OF GRAPHITE AND GRAPHITE FILMS AS BEARING SURFACES FOR USE IN NUCLEAR REACTORS. K. F. Phillips (English Electric Co. Ltd., Whetstone, Eng.). Preprint Paper No. 6. London, The Institution of Mechanical Engineers, 1962. 2p.

The coefficients of friction for both graphite and graphite films sliding against metal were initially 0·06 in carbon dioxide and 0·25 in air at temperatures up to 400°C. With progressive sliding at elevated temperatures in carbon dioxide or in air, the coefficient of friction increased often to unity. This increase in friction is associated with a flattening and polishing of the graphite surface. After mixing impurities with the graphite, both the degree of polishing obtained and the maximum coefficient of friction were lower. The effective life of dry lubricants was increased by having a reservoir of the lubricant in grooves on the metal surface. Graphite has the advantage over unlubricated metal at elevated temperatures of being capable of remaining in stationary contact for long periods without the surfaces adhering to each other. (auth)

29433 EFFECTS OF DISPERSIONS ON THE RECRYSTALLIZATION AND DUCTILE-BRITTLE, TRANSITION BEHAVIOUR OF TUNGSTEN. R. I. Jaffee, B. C. Allen, and D. J. Maykuth (Battelle Memorial Inst., Columbus, Ohio). p.770-98 of "Powder Metallurgy in the Nuclear Age. Fourth Plansee Seminar, June 20-24, 1961, Reutte/Tyrol." Reutte/Tyrol, Metallwerk Plansee A. G., 1962. (In English)

Sintered tungsten-base alloys with up to 10 volume per cent of fine oxide may be fabricated to strip by conventional hot working procedures. ThO_2, ZrO_2, HfO_2, Al_2O_3, and UO_2 are stable, while SiO_2 and MgO are volatilized during vacuum sintering. TiN, ZrN, HfN, TaN, HfC, TaC, and Ta_2C are not stable, with nitrogen, carbon, and titanium being evaporated in vacuum sintering, leaving the residual metallic elements. Residual tantalum and hafnium are detrimental to fabricability, but zirconium is not. Primary recrystallization temperatures are raised as much as 200°C by $ThO_2 + Na_2O$ dispersion, ZrO_2, and residual Zr or Ta. Secondary recrystallization was retarded up to over 2700°C with the $ThO_2 + Na_2O$ dispersion. The ductile-brittle transition in bending could be lowered as much as 90°C. by dispersions, with $ThO_2 + Na_2O$ being the most effective. (auth)

29434 SURFACE PHENOMENA IN METALS AND ALLOYS. V. K. Semenchenko. Translated from the Russian by N. G. Anderson. R. Kennedy, ed. Adiwes International Series in Metallurgy and Materials. Addison-Wesley Series in Metallurgy and Materials. Oxford, Pergamon Press Ltd., 1962. 486p.

Fundamentals of the classical thermodynamic theory of surface phenomena, which was originally given by Gibbs, and the elements of the molecular theory of surface phenomena in solutions are set forth. The results of investigations of the surface tension of metals and of certain properties of solid metals connected with it are included. (P.C.H.)

Radiation Effects

29435 (ANL-6428) THE EFFECTS OF IRRADIATION ON SOME BINARY ALLOYS OF THORIUM–PLUTONIUM AND ZIRCONIUM–PLUTONIUM. J. A. Horak, J. H. Kittel, and H. V. Rhude (Argonne National Lab., Ill.). July 1962. Contract W-31-109-eng-38. 16p.

A specimen of cast thorium-5 wt % plutonium and one of thorium-10 wt % plutonium were irradiated to total atom burnups of 1.9 and 2.6%, respectively, at maximum fuel temperatures of approximately 450°C. Both alloys displayed excellent dimensional stability with volume increases of 0.8 and 1.2% per atom per cent burnup, respectively. Three cold-rolled specimens of zirconium-5 wt % plutonium and one cold-rolled specimen of zirconium-7

wt % plutonium were also irradiated. The zirconium–plutonium alloy specimens all showed extremely poor dimensional stability, with anisotropic elongations ranging from approximately 100 to 500%. The irradiation growth coefficients for these specimens ranged from 90 to 210 microinches per inch per atom per cent burnup. The poor dimensional stability of the zirconium–plutonium alloy specimens is attributed to a highly preferred grain orientation that presumably developed during cold rolling. (auth)

29436 (DOFL-TR-975(Suppl.1)) NUCLEAR RADIATION DAMAGE TO TRANSISTORS. VOLUME II. PERMANENT DAMAGE. PART 1. THEORETICAL ASPECTS. Martin J. Cooper and M. Gay Payne (Diamond Ordnance Fuze Labs., Washington, D. C.). June 28, 1962. 24p.

A mathematical analysis of neutron damage to transistors is presented. The approach involves statistical considerations of the variation of minority carrier lifetime τ, thereby providing a direct calculation of the damage factor K, previously considered an empirical constant. It is thus possible to calculate the change of common-emitter current gain (β) and collector leakage current (I_{co}) due to neutron exposure. Calculations agree reasonably well with experimental observations. (auth)

29437 (GA-2984) EFFECT OF PULSED GAMMA RADIATION ON INFRARED DETECTORS. V. A. J. Van Lint, John Roes, and D. E. Willis (General Atomic Div. General Dynamics Corp., San Diego, Calif.). June 1962. Contract AF 29(601)-2818. 82p. (AFSWC-TDR-62-29)

The response of various infrared detectors to a pulse of nuclear radiation was analyzed theoretically and experimentally. The detectors studied included photoconductive lead sulfide, lead-selenide, and gold-doped germanium detectors, as well as an indium-antimonide photovoltaic junction detector. The lead sulfide and lead-selenide detectors were operated at room temperature; the others were tested at liquid nitrogen temperature. On the absolute basis, the detector which was most sensitive to radiation was gold-doped germanium and the least sensitive was lead selenide. However, the radiation-induced signals were of the same order as the infrared sensitivity; hence, without comparing the infrared and radiation response, it is impossible to conclude which of these detectors would be most satisfactory in a radiation environment. Since the mechanisms responsible for the radiation response and those occurring during infrared excitation are quite similar, this rough correspondence between radiation sensitivity and infrared sensitivity is not surprising. (auth)

29438 (GEMP-14A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 14, PART A. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Aug. 15, 1962. Contract AT(40-1)-2847. 26p.

Studies of radiation effects on BeO are divided into three parts: composition series, grain size-density series, and special studies. Additional post-irradiation measurements were completed on composition series specimens, further studies were made of preferred orientation and its influence on properties, and the irradiations of the grain size-density series were continued. The results provided further evidence that lattice expansion saturates in 100°C irradiations at about 5×10^{20} n/cm^2($\geq$ 1 Mev). The expansion and strength of specimens irradiated at 800 and 1000°C showed the expected trend of greater radiation stability for higher irradiation temperatures. Irradiation at 300°C, however, did not minimize damage in the dose range of 2 to 4×10^{20} n/cm^2($\geq$ 1 Mev). Property changes were comparable to those in 100°C irradiations. (auth)

29439 (KAPL-1866) SILICA–URANIUM FUEL SYSTEMS. [PART] II. W. M. Cashin and W. H. Howland (Knolls Atomic Power Lab., Schenectady, N. Y.). Sept. 9, 1957. Contract W-31-109-eng-52. 16p.

Data on the results of irradiating VYCOR–U_3O_8 fuel elements, VYCOR containing boron-10, and uranium-containing glass, as well as data concerning fission-gas release are presented. The method for preparing VYCOR-U_3O_8 fuel elements is described. The results indicate that silica–uranium systems present a promising approach to high-temperature fuel development. (auth)

29440 (NAA-SR-7248) IRRADIATION BEHAVIOR OF URANIUM CARBIDE FUELS. D. I. Sinizer, B. A. Webb, and S. Berger (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 15, 1962. Contract AT(11-1)-Gen-8. 47p.

Fission gas release or diametral increase of fuel do not represent limitations on the use of U-C fuel elements, under presently conceived Na-cooled reactor conditions. Observed diametral change and fission gas release rates can be accommodated in properly designed elements. Observations of diametral increase on arc-cast U-C, bonded with Na or NaK, can be correlated by the empirical equation $R_D = 0.6 + 0.77\ (T_R/1000 - 1)^5$ where R_D = % diametral change per % burnup, and T_R = center temperature (°R). Fission gas release can increase, where there is a diffusion reaction between fuel and cladding or thermocouple sheaths to form a liquid or solid metallic phase. In general, this can be of significance in instrumented capsule tests, where a central thermocouple sheath is in contact with fuel at a relatively high temperature. It is of less significance in a fuel element where fuel-cladding contact occurs only at a relatively low surface temperature. Transfer of C from hyperstoichiometric U-C fuel to stainless steel cladding, across the Na bond, was observed in both in-pile and out-of-pile experiments. There is no evidence to support the possibility of irradiation-induced acceleration of the C transfer process. No C transfer is observed with hypostoichiometric U-C under irradiation. The C removed from hyperstoichiometric U-C fuel is readily transferred across the Na bond to carburize and embrittle stainless steel cladding in both in-pile and out-of-pile experiments. Fuel cracking is observed, in irradiation experiments, to occur on either transverse or radial planes, probably because of thermal stresses. The observed crack pattern is not believed to be detrimental to the performance of U-C fuels. The crack pattern is similar, for both hypostoichiometric and hyperstoichiometric fuel. It is concluded that stoichiometric or hypostoichiometric U-C, Na-bonded to stainless steel, can be effectively used in Na-cooled power reactors to center temperatures of 2000°F and burnup of 25,000 Mwd/MTU, with cladding temperature of 1200°F. Alternatively, Zircalloy-clad Na-bonded elements with hyperstoichiometric U-C can be used to the same central temperature and burnup, with cladding temperature limited by cladding strength to about 1150°F. (auth)

29441 (TID-16378) INTERPRETATION OF ANNEALING SPECTRA OF THE NOBLE METALS. Technical Report No. 29. John William DeFord (Illinois. Univ. Urbana). June 1962. Contract AT(11-1)-182. 65p.

Experimental results obtained by various workers concerning the annealing spectra of noble metals are analyzed. The current interpretation concerning annealing spectrum is stated and a summary of theoretical results on possible defect configurations is presented. An explanation for the differences in the annealing spectrum between Au, and Cu and Ag is advanced. (J.R.D.)

29442 (UCRL-13044) DETERMINATION OF OPTIMUM MATERIALS FOR FLAT CABLE MANUFACTURE. Alfred E. Mason (General Motors Corp. Packard Electric Div. Product Engineering Lab., Warren, Ohio). [1962]. For California. Univ., [Livermore]. Lawrence Radiation Lab.). Contract W-7405-eng-48. 143p.

An investigation was conducted to determine the optimum material for use in flat cable manufacture. Data were also obtained concerning radiation effects on polymeric materials such as polyethylene, polypropylene, polyester-polyethylene terephthalate (mylar), ethylene co-polymer (Marlex 5003), and an amine derived material (H film). Other data are included which were obtained in electrical, mechanical, and chemical tests. (J.R.D.)

29443 (AEC-tr-5325) STUDY OF IRRADIATION DISORDER OF THE U_2Mo PHASE. J. Bloch, J. Doulat, and J. Blin. Translated by Eugene E. Gruber, Jr. (Carnegie Inst. of Tech., Pittsburgh) from J. Nuclear Materials, 3: 327-30(Mar.-Apr. 1961). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 24064.

29444 INTERACTIONS BETWEEN INTERSTITIAL AND SUBSTITUTIONAL SOLUTES IN AN H.C.P. LATTICE. D. Gupta and S. Weinig (Univ. of Illinois, Urbana and Materials Research Corp., Orangeburg, N. Y.). Acta Met., 10: 292-8(Apr. 1962).

The reported results of interstitial stress-relaxation studies in hexagonal metal systems have been somewhat controversial. Out of the two possible interstitial holes in the α-Ti lattice, viz. octahedral and tetrahedral, only the octahedral ones are large enough to accommodate an oxygen atom. However, the octahedral sites remain isotropic under an externally applied stress and therefore would not exhibit a stress-induced relaxation phenomenon. In contradiction to this, Pratt, Bratina, and Chalmers have reported that the introduction of oxygen into α-Ti caused the appearance of a peak in the relaxation spectrum. An investigation was conducted on binary (Ti-O) and several dilute ternary (Ti-O-Me) alloys. These peaks are attributed to a localized distortion of the octahedral sites caused by the substitutional solute atoms. The distortion makes one interstitial site energetically favorable to another and hence an interstitial atom will jump from one position to another under the influence of an externally applied stress. (auth)

29445 A THERMALLY ACTIVATED INTERNAL FRICTION SPECTRUM IN COPPER FOLLOWING NEUTRON IRRADIATION. D. O. Thompson (Oak Ridge National Lab., Tenn.). Acta Met., 10: 327-31(Apr. 1962).

Measurements of the internal friction and Young's modulus of a neutron-irradiated copper single crystal as a function of temperature indicate that some conversion of the primary dislocation pinning defect in the range of 270°K to about 400°K takes place in the dislocation neighborhoods. This conclusion is based upon the observation that, with the cessation of bombardment and a presently unspecified incubation period, a thermally activated internal friction spectrum is developed, which is characterized by an energy of about 0.56 ev. These experiments differ from previous work in this field in that an effort is made to allow the dislocation-defect distribution to reach complete thermal equilibrium without the steady-state addition of more defects to the dislocations by continuing bombardment. It is felt that the incubated spectrum may be divacancy controlled, and that the activation energy of 0.56 ev may be interpreted as the motion energy of the divacancy near the dislocations. (auth)

29446 TEMPERATURE DEPENDENCE FROM 250°K TO 370°K OF DISLOCATION PINNING IN COPPER SINGLE CRYSTALS BY RADIATION DEFECTS. V. K. Pare and D. O. Thompson (Oak Ridge National Lab., Tenn.). Acta Met., 10: 382-9(Apr. 1962).

Measurements of internal friction and modulus defect at 15 kc/s were used to study, in the neighborhood of room temperature, the pinning of dislocations in copper crystals by fast-neutron-induced defects. By measuring at various constant temperatures the delayed pinning following a short irradiation, a delay time distribution for the pinning defects was obtained and the process was found to be governed by a single activation energy, 1.1 ev. Although this energy is reasonable for the diffusion of vacancies to dislocations, the shape of the delay time distribution does not agree with theory and the apparent number of jumps at the end of the process is anomalously low. (auth)

29447 TEST INSTALLATION FOR HIGH TEMPERATURE FUEL ELEMENTS. W. R. Ruston (Societe d'Études, de Recherches et d'Applications pour l'Industrie, Brussels). Atomwirtschaft, 7: 305-8(June 1962). (In German)

A test loop for the measurement of the diffusion of fission products from high-temperature fuel elements under irradiation constructed at the BR-1 Reactor in Mol is described in detail. The loop is divided into two pressure stages, a high-pressure part with compressor, pressure vessel, heating section, and heat exchanger and a low pressure part with filters and measuring equipment. (tr-auth)

29448 THE BEHAVIOR OF EXPLOSIVES UNDER THE IMPACT OF γ-RADIATION. [PART I]. E. Piantanida and M. Piazzi. Chim. Ind. (Milan), 42: 1238-42(Nov. 1960).

Smokeless powder (nitrocellulose with various gelatinizing and plasticizing agents) was exposed to Co^{60} γ radiation at dosages ranging from 0 to 15×10^6 r and pressures from 0 to 300 mm Hg. The stability of the powder under varying doses and pressures was examined. The 4 samples studied consisted of powders of (a) gelatinized smokeless powder with 7% centralite, (b) gelatinized smokeless powder with 5% centralite and 3% butylphthalate, (c) gelatinized smokeless powder with 2% centralite and 5% phthalic anhydride, (d) gelatinized smokeless powder dissolved in acetone which was subsequently evaporated. The excellent protective action of centralite against γ radiation was confirmed by numerous experiments. (OID)

29449 THE BEHAVIOR OF EXPLOSIVES UNDER THE IMPACT OF γ-RADIATION. PART II. E. Piantanida and M. Piazzi. Chim. Ind. (Milan), 43: 1389-93(Dec. 1961).

Three types of demolition explosives were exposed to Co^{60} γ radiation, namely, (a) picric acid (pertite) and trinitrotoluol (TNT), (b) erythrityl tetranitrate (pentrite, PETN), and (c) cyclotrimethylenetrinitroamine (cyclonite, RDX). Samples of these substances in crystalline powder were irradiated with 5×10^6 to 20×10^6 r from 0 to 720 min under pressures from 0 to 25 mm Hg, and the data were plotted for stability under various pressures and radiation energies. Results showed that the aromatic nitroderivatives (a) were extremely stable to γ radiations up to 20×10^6 r. However, the nitrated esters (b) were extremely labile and exploded immediately upon radiation with 3×10^6 r, while nitramines (c) exhibited stability between groups (a) and (b). (OID)

29450 THE EFFECTS OF RADIATION ON THE DIELECTRIC PROPERTIES OF RUBBERS. Ukichi Shinohara and Yoneichi Inagaki. Denki Gakkai Zasshi, 81: 1599-1605 (Oct. 1961).

Five different samples (~1 in. thick each) including 2 types of natural rubber, butyl rubber, neoprene gum, and

silicone elastomer were irradiated by γ rays from a 3000-c Co^{60} source at the rate of 5×10^5 r/hr in air or in nitrogen gas occasionally. The effects observed at dose levels of 10×10^6 r, 20×10^6 r, 40×10^6r, and 80×10^6 r were: the molecular weight increased on oxidation, but decreased on reduction; the dielectric characteristics of the near nonpolar rubbers were deteriorated by oxidation; the dielectric properties of the polar neoprene gum variations were dependent upon the polar radicals and cross-linking rather than oxidation; and the molecular weights of all rubbers decreased when the samples were irradiated in N_2, with neoprene rubber showing the largest. The results further confirmed the influence of the atmospheric condition under irradiation on these electrical insulating materials. (OID)

29451 THE EFFECTS OF RADIATION ON THE DIELECTRIC PROPERTIES OF POLAR HIGH POLYMERS. Yoneichi Inagaki and Ukichi Shinohara. Denki Gakkai Zasshi, 81: 1795-1802(Nov. 1961).

Samples of polar high polymers with the C–Cl radical as PVC, neoprene gum, and polymonochlorotrifluoroethylene were irradiated by a 3000-c Co^{60} γ-ray source or by fast neutrons. The results obtained were different from those obtained with nonpolar high polymers, such as polyethylene. In the case of PVC, the dielectric constant and the loss tangent for nonplasticized samples increased rapidly at a certain dosage but varied little with an increase in the stabilizer, Tribase, content. The dielectric characteristics of neoprene gum varied because of the irradiation breakage of the C–Cl bond. Polymonochlorotrifluoroethylene became brittle at lower radiation dosages and showed considerable changes in the mechanical properties but few changes in the dielectric properties. The effects of irradiation on the dielectric characteristics, even with the same polar C–Cl radical in the molecules, differed depending upon the molecular structure. (OID)

29452 STUDY OF A SEEDED PLASMA. Robert Sylvester Buchanan (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 169(July 1962).

A method for increasing the electrical conductivity of a gas by introducing a foreign element into the gas flow, and the properties of the resulting plasma were studied. The important chemical reactions which take place when a fluid is seeded were analyzed as a function of temperature and pressure. The seeding elements considered were the alkali metals, alkaline earths, and aluminum. The elements were selected on the basis of their relatively low ionization potential. The fluids considered were air, oxygen, and nitrogen, although the results are applicable to any fluid. The theoretical ionization process was developed including the excited electron energy states. Finally, the simultaneous solution of the governing equations resulted in a quadratic equation giving the free electron concentration of the seeded fluid. An RF plasma generator, used as the test facility, produced a steady state temperature of approximately 3000°K at atmospheric pressure. Seeding was accomplished using an aqueous solution of sodium nitrate, injected into the fluid with an atomizer before the mixture entered the RF field. The atomizer was energized by the unseeded gas (nitrogen), giving a well mixed, steady flow system. It was concluded that: the most favorable seeding element for thermal ionization of seeded air is that with the lowest ionization potential, although the stability of the MO gaseous molecules are of significance for the seeding elements considered; if seeding is to be accomplished in a combustion region for diagnostic purposes, sodium or potassium should be used because of the relatively high stability of the MOH gaseous molecules of the other seeding elements; and the collision cross sections of the neutral sodium atom and the singly ionized sodium atom do not appear to be sufficiently large to influence the effective collision frequency of the plasma at the seeding rates tested. (auth)

29453 ROLE OF CERIUM IN SUPPRESSION OF GAMMA-RAY INDUCED COLORING OF BORATE GLASSES. Adli M. Bishay (Argonne National Lab., Ill.). J. Am. Ceram. Soc., 45: 389-93(Aug. 1962)

The role of cerium in the suppression of gamma-ray induced coloration in glass was found to depend on the relative concentration of Ce^{3+} to Ce^{4+} ions as well as on the total cerium content. In a borate glass having high ultraviolet transmission, it was found that both Ce^{3+} and Ce^{4+} ions are necessary to suppress the optical absorption bands induced in the visible region. The role of cerium can be explained on the basis of a change in its oxidation state as a result of gamma irradiation. It is postulated that the cerous ions, by the reaction $Ce^{3+} \rightarrow Ce^{4+} + e$, suppress the induced visible band at 2.36 ev (525 mμ), which may result from positive hole centers. High cerous ion concentration results, however, in an induced center ($Ce^{3+} + e$) which absorbs in the visible at about 1.9 ev (650 mμ). The presence of Ce^{4+} ions near Ce^{3+} prevents the formation of this center possibly by the reaction $Ce^{4+} + e \rightarrow Ce^{3+}$. These induced opposite changes in the oxidation state of cerium tend to maintain a balance in the ratio of Ce^{3+} to Ce^{4+} ions in the glass during irradiation, and the suppression of the visible bands depends on this ratio. (auth)

29454 ELECTRON MICROSCOPE OBSERVATION OF A RADIATION-NUCLEATED PHASE TRANSFORMATION IN MICA. P. B. Price and R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys., 33: 2625-8(Aug. 1962).

Synthetic fluor-phlogopite mica samples were irradiated with fission fragments, stripped into thin sheets (≳ 3000Å), and annealed in air at various temperatures to study the behavior of the tracks formed along the paths of the fission fragments. Transmission electron microscope observations showed that the appearance of the tracks was unaltered below 775°C. At ~800°C tracks began to thicken at their intersections with the mica surfaces and to thin in the region between the surfaces. The thickened ends grew into platelike particles whose selected area diffraction patterns were consistent with that of forsterite. This compound was known to be formed during the high-temperature decomposition of unirradiated mica. The experiments thus demonstrated that individual fission fragment tracks could serve as nucleation sites for a phase transformation in mica. (auth)

29455 REACTIONS OF CARBOXYLATED BUTADIENE-STYRENE RUBBERS AND THEIR MIXTURES WITH ε-CAPROLACTAM INDUCED BY γ-RADIATION. I. Mladenov, I. A. Tutorskiĭ, and B. A. Dogadkin (Moscow Inst. of Fine Chemical Tech.). J. Polymer Sci., 61: 235-42 (Sept. 1962).

Carboxylated butadiene-styrene rubber containing various amounts of styrene and methacrylic acid were exposed to 0.1 to 50 Mr doses of γ radiation from a Co^{60} source. This irradiation resulted in a decrease in the carboxyl group content, particularly at low doses. The radiochemical yield of crosslinked polymers at low doses is a linear function of the carboxyl group content of the initial polymer. The number of crosslinks formed by the carboxyl groups at doses up to 20 Mr calculated from the maximum swelling data were found to agree satisfactorily with the number of crosslinks as calculated from the carboxyl group consumption. Irradiation of the carboxylated rubber

in mixtures with ϵ-caprolactam gives rise to addition of the latter to the rubber with formation of insoluble compounds. The amount of caprolactam combining with the rubber increases linearly with an increase in ϵ-caprolactam content of the original mixtures in the range of 5 to 50%. There is also an increase in the degree of crosslinking. An increase in the bound ϵ-caprolactam content leads to an increase in the tensile strength of the polymer. (auth)

29456 RADIATION SELF-DAMAGE IN PLUTONIUM COMPOUNDS. M. H. Rand, A. C. Fox, and R. S. Street (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 195: 567-8(Aug. 11, 1962).

Results which show that the lattice parameters of plutonium compounds increase continuously when kept at room temperature owing, it is suggested, to the displacement of atoms to interstitial sites by the α-disintegration of the plutonium are reported. For $Pu^{238}O_2$ the increase is perceptible (0.02%) after two months and appreciable (0.1%) after a year. X-ray pictures were taken of samples of $PuC_{0.8}$, $PuN_{0.9}$, PuO_2, and Pu_2C_3 (isotopic composition 97% Pu^{239}, 3% Pu^{240}) at intervals of about 2 months, without removing them from closed argon-filled capillaries in which they were stored (at room temperature) between exposures. An x-ray picture was also taken of a different PuO_2 sample 1253 days after it was prepared. During this period, the cell parameter increased from 5.3950 to 5.4085 Å. The calculated limiting value of Δa/a for α-damage in Pu_2C_3 was 1.25×10^{-3} and for PuO_2 was 3.9×10^{-3}. The expansions for $PuC_{0.8}$ and $PuN_{0.9}$ were larger; after only 277 days α-damage, Δa/a for $PuC_{0.8}$ was 1.67×10^{-3} and seemed to be increasing almost linearly. (P.C.H.)

29457 REACTOR-RADIATION EFFECTS ON STRUCTURAL MATERIALS. Frederic R. Shober (Battelle Memorial Inst., Columbus, Ohio). Nucleonics, 20: No. 8, 134-40(Aug. 1962).

Extensive tables are presented for the reactor radiation effects on the mechanical properties of structural metals and alloys. Data are given for yield strength, tensile strength, total elongation, and reduction of area of carbon steels, iron-base alloys, stainless steels, zirconium alloys, nickel alloys, aluminum alloys, and magnesium alloys. A bibliography of 55 references is included. (D.L.C.)

29458 THE INFLUENCE OF IMPURITY ATOMS ON THE ANNEALING KINETICS OF NEUTRON IRRADIATED COPPER. D. G. Martin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 7: 803-25(May 1962). (AERE-R-3843)

Spectroscopically pure copper and a series of dilute binary alloys of copper, containing between 0.02 and 1 atomic % of silver, cadmium, and beryllium respectively, are neutron-irradiated to doses of between about 10^{17} and 5×10^{17} nvt at −196°C. A series of isochronal anneals up to +150°C are performed and the recovery of the radiation damage is observed by measuring changes of the electrical resistance in liquid helium. Three principal annealing peaks at approximately −140, −60, and 0°C, which are superposed upon a continuous annealing up to 0°C, are observed for all the specimens. However, the heights and exact temperatures of the peaks vary with impurity concentration and neutron dose. From a study of these variations, together with experimental results obtained on pure copper quenched from high temperatures, it is suggested that the first two peaks are caused by the migration of interstitials from traps, and the third by migration of free vacancies. The nature of these traps is discussed. It is also shown that the details of the annealing processes in beryllium–copper are different from those of the alloys of silver and cadmium. (auth)

29459 X-RAY STUDY OF INTERSTITIAL DEFECTS IN RADIATION-DAMAGED ALKALI HALIDES AND LiH. F. E. Pretzel and R. L. Petty (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 777-86(Aug. 1, 1962).

The effects of exposure to tritium β particles at 77°K on the lattice parameters of Si, LiH, LiF, NaCl, KCl, and KBr were examined by x-ray diffraction studies by employing a sample stage cooled by liquid nitrogen. The Si and LiH lattice parameters remained constant during β irradiation from an external source, but all of the alkali halides showed large increases in lattice parameter. Maximum unit cell volume expansions observed were 0.2% in LiF, 0.6% in NaCl and KCl, and 0.3% in KBr. Measurements of unit cell expansion and bulk crystal expansion of LiH crystals containing LiT were also continued to determine more accurately the expansion per interstitial He^3 atom. The results are interpreted on the basis of the formation of Frenkel pairs (interstitial anion plus anion vacancy) in the alkali halides by a moderately efficient process. The process involves the transport of interstitial defects through 50 μ into materials for which the β range is about 2 μ. It is proposed that this may occur either directly, by an interstitialcy mechanism, or indirectly, by exciton interactions within the crystals. Comparisons between the results of low-temperature studies of lattice expansion and color centers in alkali halides are made, and possible interrelations between the various defects formed by radiation damage are proposed. (auth)

29460 VARIATION OF RADIATION DAMAGE PARAMETERS IN METALS. P. G. Lucasson and R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 127: 1130-6(Aug. 15, 1962).

Electron damage measurements have previously been used to obtain values for the average threshold energies and for the electrical resistivities of Frenkel pairs in a number of metals. It is shown that there is an empirical correlation between the point defect resistivities so obtained and the normal, high-temperature electrical resistivities of different metals. The threshold energies are discussed and extrapolations are made to predict values for certain metals whole threshold energies have not yet been measured. The low-temperature (stage I) recovery of most of the metals studied is shown to be qualitatively similar to that in copper, and the correlation of recovery temperatures with certain bulk properties is discussed. The radiation damage parameters derived from the electron results are used to compare theory and experiment for irradiations performed with heavy particles. It is shown for neutron irradiations that there is a general tendency for the simple displacement theory to give better agreement with experiment as the atomic weight of the bombarded material increases. (auth)

29461 EFFECT OF NEUTRON IRRADIATION ON THE FERROELECTRIC PROPERTIES OF BARIUM TITANATE CERAMICS. B. Hilczer (Inst. of Physics, Polish Academy of Science, Poznan). Phys. Status Solidi, 2: 447-55(1962). (In English)

The changes in ferroelectric properties of barium titanate ceramics caused by irradiation with reactor neutrons were investigated. The temperature dependence of the dielectric permittivity and the temperature hysteresis of barium titanate ceramics nonirradiated and irradiated with an integrated neutron flux from 10^{14} to 10^{19} n/cm^2 were measured. Moreover, the changes in the dielectric hysteresis loop of barium titanate ceramics caused by neutron irradiation were investigated. (auth)

29462 A COMPARISON OF THE EFFECTS OF ULTRAVIOLET AND GAMMA RADIATION IN POLYMETHYLMETHACRYLATE. A. Charlesby and D. K. Thomas (Royal Military Coll. of Science, Shrivenham, Swindon, Wilts, Eng.). Proc. Roy. Soc. (London), A, 269: 104-24(Aug. 21, 1962).

The exposure of polymethylmethacrylate (PMM) to high-energy γ or electron radiation produces a degradation of the molecular chains. This may result from either ionization or excitation. Ultraviolet light results in excitation only. The effects of these forms of radiation are compared. The degradation of PMM is studied in thick or thin films, and in solutions in benzene. It is found that at room temperature degradation (random main-chain fracture) occurs with ultraviolet radiation, whereas at higher temperatures the reaction is one of chain depolymerization. The energy absorbed per main chain fracture is about 550 ev with ultraviolet radiation, so that less than 1% of the quanta absorbed are effective; this compares with about 65 ev of γ energy absorbed per fracture. Apart from this difference in efficiency, the two reactions are very similar. In both cases the number of fractures is proportional to dose, and the radicals formed are identical in character. Somewhat similar changes also appear in the optical spectrum, although these may be modified by surface oxygen. The results show no significant contribution from any ionization produced by high-energy radiation. (auth)

29463 FISSION FRAGMENT DAMAGE TO CRYSTAL LATTICES: DISLOCATION FORMATION. F. P. Bowden and L. T. Chadderton (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A, 269: 143-64(Sept. 11, 1962).

The disorder in the molecular array of a crystal lattice caused by a fission fragment has been studied by high-resolution electron microscopy. Disturbances in the (201) fringes of platinum phthalocyanine have been observed and a limited theoretical interpretation of these disturbances suggests that complex dislocation arrays are formed over an area which is easily determined. In particular there is evidence that dislocation dipoles can remain behind in a crystal after fission fragment bombardment. Molecular planes are shown to curve inward toward the localized regions of damage. Observations made on the optical absorption spectra of copper and platinum phthalocyanine, both irradiated and unirradiated, are also described. The technique of irradiating thin crystals with fission fragments and observing the resultant damage in the electron microscope has been extended to other materials. In moiré patterns on overlapping crystals of molybdenum trioxide there is further evidence of a curvature of the molecular planes near regions of damage and in molybdenum disulfide dislocations resulting from irradiation are revealed by diffraction contrast. There is evidence that the radiation damage to the crystal lattice can be due to both thermal and displacement spikes and their relative importance is dependent on the nature of the crystal. (auth)

29464 DOSIMETRY BY THERMOLUMINESCENCE. I. THE EFFECTS OF RADIATION ON SOLIDS. R. Schayes and A. Bruaux. Rev. M.B.L.E., 5: 107-29(June 1962). (In French)

Thermoluminescent phenomena are surveyed. The energy of a single particle undergoes degradation by distribution among a great number of other particles, and one is led to study the effects of particles with less and less energy up to the stage where the evolution of the energy can be considered as stopped. This end of energy evolution can take either the form of heat degradation or, at a much lower rate, the form of a permanent potential energy storage. In the final stages of the evolution, the energies exchanged are comparable to the energy differences arising from the electron structure of the crystal lattice. Solid state physics must then be briefly considered. (auth)

29465 INFLUENCE OF IRRADIATION ON THE DIELECTRIC STRENGTH OF THIN ROCK SALT LAYERS. G. A. Vorob'ev and V. A. Kostrygin (Tomsk Polytechnic Inst., USSR). Soviet Phys.-Solid State, 4: 595-6(Sept. 1962).

Dielectric breakdown is studied in 0.01-mm-thick rock salt samples that are exposed to varying intensities of uv light. The breakdown voltage is found to fall as the uv intensity increases, in agreement with a multi-avalanche mechanism of breakdown. (T.F.H.)

29466 THERMAL ANNEALING OF NEUTRON IRRADIATED POTASSIUM SULFATE. Nikola Getoff, Masaru Nishikawa, and Peter Meindl (Institut für Radiumforschung und Kernphysik, Österreichischen Akademie der Wissenschaften, Vienna). Z. Naturforsch., 17a: 533-6(June 1962). (In German)

The thermal annealing of neutron-irradiated potassium sulfate at various temperatures was studied. It could be established that 21% of the radiosulfur is present as the sulfite and the rest as sulfate. The rate constant of the annealing process of the recoil fragments increases from 5.25×10^5 sec^{-1} at 100°C to 6.63×10^{-5} sec^{-1} at 175°C. The Arrhenius equation was assumed to be valid for solid materials and the activation energy of the annealing of the fragments formed was calculated. This increases stepwise with the temperature and reaches at 175°C a value of 1.5 kcal/mol. The thermal distribution of the radioactive phosphorus originating in the (n,p) process was investigated. The largest part of the phosphorus is present in an unknown form. Only 3.3% of the total mass was isolated as the orthophosphate. By thermal treatment of the irradiated material, the unknown phosphorus compound is converted 2.5% into the orthophosphate and 10% into the pyrophosphate. (tr-auth)

29467 THE EFFECT OF NEUTRONS ON TRANSISTORS, ESPECIALLY Ge TRANSISTORS. Ferdinand Nibler (Technische Hochschule, Munich). Z. angew Phys., 14: 394-8(July 1962). (In German)

After a brief review of the radiation damage of Ge and Si, measurements on the modification induced in Ge transistors by neutron irradiation are described. It is shown that at doses of approximately 10^{10} neutrons/cm^2 practically no permanent damage occurs and that at doses of more than 10^{11} neutrons/cm^2 practically all transistors are incapable of functioning. The behavior of transistors agrees basically in the transition range, but the individual critical doses are different. Assumptions on the behavior of circuits in the transition range are possible to only a very limited extent. (tr-auth)

29468 SURVEILLANCE OF CRITICAL REACTOR COMPONENTS TO ASSESS RADIATION DAMAGE. L. E. Steele and J. R. Hawthorne (Naval Research Lab., Washington, D. C.). Preprint Paper No. 67. New York, Engineers Joint Council, 1962. 29p.

A technique, called "surveillance", for resolving uncertainties of dose rate and spectrum effects is described which involves the exposure of specimens of the appropriate steels at critical points in power reactors. An explanation is included of the need, analysis of techniques, and description of the features of long-term reactor surveillance programs. Experimental results on the notch ductility of irradiated A212-B steel are summarized. (L.T.W.)

PHYSICS

General and Miscellaneous

29469 (AFOSR-2715) THE THEORY OF ALIGNED-FIELDS MAGNETOGASDYNAMIC FLOWS. A. R. Seebass (Cornell Univ., Ithaca, N. Y. Graduate School of Aeronautical Engineering). June 1962. Contract AF 49(638)-544. 90p.

The isentropic flow of an ideal conductor in the presence of a magnetic field is treated for the case of aligned fields. Particular attention is paid to flow regimes where the existing linearized theory fails because of a change in character of the governing equations. The equations for the stream function and a new potential function are derived, and the behavior of their characteristics determined. These equations are then transformed to hodograph variables, in which they become linear. Several exact solutions are considered in detail. Separation of variables in these hodograph equations results in a complicated differential equation, which is discussed briefly. The approximate equations appropriate to each transition are derived, and solutions exhibiting these transitions are given. (auth)

29470 (AFOSR-2759) NORMALIZATION CONDITION FOR THE BETHE-SALPETER WAVE FUNCTION AND A FORMAL SOLUTION TO THE BETHE-SALPETER EQUATION. Iwao Sato (Maryland. Univ., College Park). June 1962. Contract AF49(638)-24. 40p. (TR/262)

By the use of an inhomogeneous Bethe-Salpeter equation a normalization condition for the Bethe-Salpeter wave function is obtained. This condition requires the normalization integral to be positive. A formal solution is obtained in the ladder approximation, and convergence of the normalization integral is proved by the use of this solution. This solution is also used to prove a dispersion relation for the vertex function of the compound particle, and to give an approximate solution. The positiveness of the normalization integral is proved in the nonrelativistic limit. The bound state of nucleon and antinucleon is studied in the ladder-chain approximation, and it is found that the normalization condition gives finite wave function in spite of divergency of the normalization integral. (auth)

29471 (ANL-6574) PHYSICS DIVISION SUMMARY REPORT, JUNE 1962. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 41p.

An investigation of charged particles is reported in which groups of alpha particles whose angular distributions correspond to $l = 2$ are seen at excitations of about 1 Mev in all targets studied. These targets also yield groups of $l = 3$ alphas at about 4 Mev excitation. These groups are usually excited more strongly in even-even targets than in odd-A targets. For the targets studied, the 3^- cross section increases with A, while the 2^+ cross section shows no regular variation with A. In other work, preliminary results were obtained on the elastic scattering of 8-Mev protons from Ca^{40}, Ni^{58}, Ni^{60}, Cu^{63}, and Cu^{65} using the tandem Van de Graaff generator. Revised values of the widths of some of the unbound levels of F^{20} are given. Many peaks were observed in the 130 to 300 kev region but an analysis of these peaks is deferred until inelastic scattering can be taken into account. In plasma physics, a photographic and visual study of the structure of high-frequency plasmoids as related to plasmoid mechanisms is described. In theoretical physics, transition strengths of neutron pickup reactions are calculated for 1 $F_{\frac{1}{2}}$ nuclei. (J.R.D.)

29472 (BRL-1161) SHOCK PRODUCING MECHANISMS FOR EXPLODING WIRES. F. D. Bennett (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Feb. 1962. 34p.

Single fringe interferograms are presented of 4-mil Cu wires exploded at 20 kv into Ar at ambient pressures of $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{32}$ atm. Features discernible include a compressive head shock wave, arc plasma, a weak plasma wave, and the expanding metal wire. On the basis of certain plausible assumptions it is seen that the arc plasma has a temperature of about 2.5 ev; but its leading edge, a region not in thermal equilibrium, has electron temperatures $\sim 10^2$ ev and is the boundary of an electron-driven shock wave. (auth)

29473 (DASA-1291) FINAL REPORT ON BLAST WAVE SOLUTIONS IN HYDRODYNAMICS. G. M. Schindler and A. Trampus (General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.). May 1962. Contract DA-49-146-XZ-038. 41p. (RM62TMP-44)

A discussion of spherically symmetric blast waves of the similarity type is presented. Varying pressure and density of the ambient medium are considered along with heat flow and radiation energy loss. The two-dimensional particle-in-cell method as applied to blast wave problems involving more than one material is also examined. A new approach to axial symmetric blast waves is considered which makes maximum use of intrinsic geometrical properties. (auth)

29474 (JINR-P-989) UPRUGOE RASSEYANIE TYAZHELYKH IONOV V KVAZIKLASSICHESKOM PRIBLIZHENII. (Elastic Scattering of Heavy Ions in the Quasi-Classical Approximation). B. N. Kalinkin and B. I. Pustylnik (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 8p.

Elastic scattering of heavy ions was treated in the quasi-classical approximation. The optimal set of the nuclear interaction parameters was found which is in good agreement with experiment and holds for many cases. It is shown that in elastic scattering of heavy ions having great charges on heavy nuclei it is possible to observe the effect of the dynamic deformation. (auth)

29475 (LA-2711) ELECTROSPRAYING OF THIN TARGETS. L. N. Blumberg, Patricia Stein, and Judith C. Gursky (Los Alamos Scientific Lab., N. Mex.). May 1962. Contract W-7405-Eng-36. 12p.

Thin, uniform alpha sources and targets can be made by ejection of a solution of the active material from a fine capillary by means of an electric field. Apparatus and techniques were refined and applied to preparation of sources of some of the heavy elements. (auth)

29476 (LAMS-2701) THE T_{62} He^3 TEMPERATURE SCALE. IV. TABLES. R. H. Sherman (Los Alamos Scientific Lab., N. Mex.). June 12, 1962. Contract W-7405-ENG-36. 23p.

The detailed tables of the $T_{62}He^3$ temperature scale are presented. The vapor pressure of He^3 is tabulated in steps of 1 millidegree from 0.2 to 3.324°K, the critical temperature. A table giving temperature, to 0.1 millidegree, as a function of pressure is included, as well as the temperature derivative of the vapor pressure and deviations of previously used temperature scales. The $T_{62}He^3$ temperature scale is defined by the equation:

$\ln P_3 = -(2.49174/T) + 4.80386 - 0.286001\ T + 0.198608\ T^2 - 0.0502237\ T^3 + 0.00505486\ T^4 + 2.24846\ \ln T$, in which $0.2 \leq T \leq 3.324°K$. (auth)

29477 (NP-11910) QUARTERLY PROGRESS REPORT NO. 45 [SOLID-STATE AND MOLECULAR THEORY]. (Massachusetts Inst. of Tech., Cambridge. Solid-State and Molecular Theory Group). July 15, 1962. Contracts Nonr-1841(34) and AF19(604)-8445. 120p.

Contributions relating to research on magnetic ions in solids are presented. A study of the wave functions of rare earth ions by the Hartree-Fock method, with applications to spin-orbit interaction and related effects is included. Other work on rare earth magnetism, related to experimental work on ytterbium iron garnet is reported. The exchange interactions not only between different lattices of Fe, but also between these and the Yb ions were studied. The results give an example of a case in which the simple Dirac-Van Vleck Hamiltonian for spin-spin interaction is not adequate. Results of a lengthy study of correlation in the atomic many-body problem is also included on a method of incorporating r_{12} terms in wave functions of atoms more complicated than He; a method which may be practicable for machine calculation. The problem is very extensive, and the investigation represents one step in the whole program. The work on energy bands in solids is represented by studies concerning the effect of small changes in the exchange potential on the resulting energy bands, with the aim of finding a practical method of setting up a potential based on atomic wave functions, which will yield energy bands forming an adequate approximation to the experimental values. Calculations on Ga crystals and work on NiO crystals are proceeding. The work on molecular integrals, with application to simple molecules, is proceeding though no definite results are reported. Progress is also being made in the whole problem of programming the three- and four-center integrals. Work is reported on the interaction of two H_2 molecules, using some of the integrals. Research is reported on the use of adiabatic approximations in superconductivity theory. This is partly an outgrowth of discussions concerning the relation of the Born-Oppenheimer approximation to superconductivity theory. (auth)

29478 (NP-11930) FEASIBILITY STUDY TOWARD DEVELOPMENT OF RADIATION RESISTANT SOLAR CELL. Interim Engineering Report, November 1, 1961 – June 30, 1962. S. Kaye (Electro-Optical Systems, Inc., Pasadena, Calif.). July 31, 1962. Contract NAS7-92. 22p. (EOS-2080-IR-1)

Activities in a program for development of radioresistant solar cells are reported. The program is devoted to development of cells showing a factor of 10 improvement in radiation resistance compared with cells currently available. Radiation resistance was achieved by the use of a graded base structure in which an impurity gradient is introduced into the base region of the cell. The effect of this impurity gradient is to form an electric field in the base region of the cell which accelerates the light produced minority carriers toward the junction. Techniques were established for fabricating n on p cells with gradients of impurities in the base regions. Cells made by these techniques showed conversion efficiencies in excess of 10% when measured in sunlight. These cells, when subject to high energy electron and proton irradiation, showed a factor of 3 to 5 improvement in radiation resistance over conventional n on p cells. Irradiation results are included along with discussion of device theory and fabrication techniques. (J.R.D.)

29479 (NP-11935) THERMAL RADIATION GUIDES FOR POWER TRANSMISSION. [Progress] Report, April 1, –June 30, 1962. W. J. Swenson (Electro-Optical Systems, Inc., Pasadena, Calif.). July 15, 1962. Contract AF33(657)-8526. 33p. (EOS-3000-Q-1)

A description is presented of research in progress toward achieving transmission of radiant energy through tubes from heat sources to other locations in spacecraft without the usual Carnot-cycle-limited conversion process. The program is devoted to solving problems concerning tube shape optimization, materials, coatings, fabrication techniques, and measurement of transmission efficiencies. Efforts during the period were concentrated on development of one optimum tube shape. Descriptions of fabrication efforts, and test system checkouts are included. (J.R.D.)

29480 (NP-11967) ELECTRICALLY PROPELLED SPACECRAFT AND ASSOCIATED SUBJECTS. Literature Search No. 428. Judith Hayes, comp. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 1962. Contract NAS 7-100. 62p.

The search is divided into sections on electrically propelled spacecraft, electric propulsion and associated subjects. In each section the material is presented in categories on books, reports, and periodicals. An author index is included. The sources include Applied Science and Technology Index (AS & T), Oct. 1959 to Mar. 1962, Astronautics Information Abstracts (AI/A), Mar. 1960 to Mar. 1962, Astronautics Information Survey (AI/S), Mar. 1960 to Mar. 1962, Engineering Index (EI), 1959 to 1960, and Nuclear Science Abstracts (NSA), Jan. 1960 to Mar. 1962. 314 references. (J.R.D.)

29481 (NP-11989) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Tenth Quarterly Progress Report, March 16, 1962 through June 15, 1962. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). June 15, 1962. Contract DA 36-039-SC-78330. 84p.

A program for the study of defects in solids by electron-nuclear double resonance techniques is reported. A precise value of the O^{15} magnetic moment was obtained and compared with the known moment of the mirror nucleus N^{15}. A 47,000 gauss superconducting magnet was successfully operated. Precise values for the hyperfine splitting of a rotational transition in HDS were obtained with the maser beam spectrometer. Final results are reported on the microwave spectrum of $O^{17}H$. Precise values for the lifetimes of the first excited resonance state of Cd, Zn, Ca, and Sr were obtained by level crossing spectroscopy. A method of level crossing spectroscopy is reported in which backscattered signals are utilized to observe crossings in the presence of heavy trapping. This technique is being applied to the study of atomic collision phenomena in resonance states. A molecular beam electric resonance apparatus is being constructed for the study of molecular hyperfine structure. The high pressure microwave absorption of CO_2 was determined. This information will be used in connection with a study of the atmosphere of Venus. (auth)

29482 (NYO-9811) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report, April 1 –June 30, 1962. Research Report 62-928-441-R1. (Westinghouse Electric Corp. Research Labs., Pittsburgh). July 31, 1962. Contract AT(30-1)-2823. 9p.

Investigations were continued with zeolite traps. Results indicate that certain gases are not trapped by zeolite and must be removed by ion pumping. In experiments to obtain a cold electron source ion gage, output electron currents of several milliamperes were obtained using SiC in conjunction with an electron multiplier. Fundamental surface reac-

tion studies were continued on photodesorption of CO from W, O adsorption on W, H solubility in W, and inelastic collisions of electrons at surfaces. (J.R.D.)

29483 (R60SD330) MEASUREMENT OF THE ABSORPTION OF RESONANCE LINES. I. TEST OF METHOD ON VAPOR PRESSURE OF SODIUM. G. L. Vidale (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). May 1960. Contract AF04(647)-269. 43p.

A method was developed for studying the equilibrium vapor pressure of atomic species over refractory ceramics. It consists of measuring the absorption coefficient of the hot equilibrium vapor at the center of an atomic resonance line. A resonance line of known oscillator strength for the atomic species under examination is generated in a liquid N_2-cooled hollow-cathode discharge tube, and the absorption of this line by a known length of equilibrium vapor present in an isothermal cell is measured using spectrophotometric techniques. After correcting for the various causes of line broadening of the resonance line, the measured absorption is used to calculate the density of the atomic species. The experimental and theoretical techniques are described, and the results of a reinvestigation of the vapor pressure of Na metal at 400°K are given. It is shown that the individual vapor pressure measurements have a root mean square deviation of 12%, and that their average differs from the best literature values by less than 3%. The various sources of error are discussed quantitatively, and it is shown that pressure of 10^{-4} to 10^{-9} atmospheres of atomic species can be generally measured with an accuracy of ±20%. (auth)

29484 (TID-15143) NEUTRON DIFFRACTION STUDIES OF LOW TEMPERATURE PARAMAGNETIC ALIGNMENT IN SOLIDS. Progress Report, June 1, 1961 to February 1, 1962. C. G. Shull (Massachusetts Inst. of Tech., Cambridge). Feb. 26, 1962. Contract AT(30-1)-2592. 6p.

A major activity during the report period was the development of suitable equipment for maintaining samples, both of single crystal and polycrystalline nature, at liquid He temperatures. Development of such equipment is described. Spectrometer research activities were devoted to electron asymmetry in Fe at low temperatures, structure of $VD_{0.75}$, and low temperature structures associated with Pd and V. (J.R.D.)

29485 (TID-16383) OPTICAL EXTINCTION BY METAL PRECIPITATES IN SEMICONDUCTORS AND INSULATORS. Special Report. B. R. Gossick (Arizona State Univ., Tempe). July 1962. Contract AT(11-1)-715. 51p.

The effect on the free carrier absorption in n-type Ge and n-type Si produced by a dispersed colloidal phase of metallic precipitates is discussed. Systems of both oblate and prolate spheroidal precipitates are considered, both for the case where the axes of symmetry were aligned in parallel through strain or crystal order, and for the case where the orientation of the axes of symmetry is random. The effect of the metallic precipitates is to reduce the absorption by the electrons, but at the same time to enhance the absorption by holes. For a given fraction of volume occupied by precipitates, a random orientation of either prolate or oblate spheroids has a more pronounced effect on the free carrier absorption than spheres. The cross section for extinction by metallic spheroidal precipitates in insulators, or certain semiconductors, due to electronic plasma vibrations within the precipitates, is treated. It is shown that, with random orientation of the axes of symmetry, the characteristic spectral distribution of the extinction cross section for prolate spheroids differs from that of oblate spheroids. (auth)

29486 (TID-16477) VELOCITY DEPENDENCE OF THE DIFFERENTIAL CROSS SECTIONS, AND POTENTIAL WELL DEPTHS FROM ATOMIC BEAM SCATTERING MEASUREMENTS: K–Hg AND Cs–Hg SYSTEMS. Frederick A. Morse and Richard B. Bernstein (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). June 1962. Contract AT(11-1)-321. 130p. (ORA-03043-4-T)

Measurements of the velocity dependence of the angular intensity distribution of potassium and cesium atomic beams scattered by a crossed atomic beam of mercury are presented. The alkali atomic beam was velocity-selected, having a triangular velocity distribution with a half-intensity width of 0.047 of the peak velocity. The alkali velocity could be varied over the range 185 to 1100 m/s. The Hg beam had a thermal velocity distribution. The average speed of the Hg atoms in a typical experiment was 235 m/s (the calculated half-intensity width of the velocity distribution was 190 m/s). A typical angular distribution curve showed the expected very large low angle scattering, but evidenced a region in which the slope changed sharply, often resulting in a bump on the curve. This behavior is indicative of the phenomenon of rainbow scattering. The energy dependence of the rainbow angle was used to evaluate the depth of the interatomic potential wells; values (in ergs × 10^{14}) obtained are 7.7_3 for Cs-Hg and 7.4_8 for K-Hg. It is difficult to estimate the magnitude of the systematic errors in the absolute differential cross sections. However, reliable values for relative differential cross sections, which are velocity independent, can readily be obtained by the methods described. From the low angle behavior of the differential cross sections, direct experimental evidence for the inverse sixth power dependence of the long-range attractive part of the potential was obtained. (auth)

29487 (UAG-C-23) HIGH LATITUDE GEOPHYSICAL DATA. (Alaska. Univ., College. Geophysical Inst.). Oct. 1, 1961. 19p. (AD-266518)

Geophysical data on the polar ionospheric activity are presented. Experimental scaling methods related to earth current amplitude activity, earth current fluctuations, ionospheric absorption of cosmic radio noise, auroral radar activity indices, and magnetic activity are described. (J.R.D.)

29488 (AEC-tr-5267) ON THE THEORY OF SUPERCONDUCTIVITY. Werner Heisenberg. Translated for Los Alamos Scientific Lab., N. Mex. from Z. Naturforsch., 2a: 185-201(1947). 24p.

Results of an investigation concerning the phenomenon of superconductivity are discussed. It is suggested that the thermodynamically most stable state of an interaction which creates ordering of the thin layer of the momentum sphere bounded electrons at low temperatures gives rise to phenomena similar to superconductivity. An effort is made to determine whether the electrons in the surface layer of the momentum sphere can pass over into an ordered phase through interaction processes. The strongest interaction is that of electron electrostatic repulsion. Discussion of these forces is presented in sections on Coulomb interaction in the Fermi gas of conduction electrons, the energy of the ordered state, thermodynamic aspects, and electrodynamic equations. (J.R.D.)

29489 (AEC-tr-5269) INTERACTIONS IN A FERMI GAS — POLARIZATION PHENOMENA, CORRELATION ENERGY, AND ELECTRON CONDENSATION. Wilhelm Macke.

Translated for Los Alamos Scientific Lab., N. Mex. from Z. Naturforsch., 5a: 192-208(1950). 32p.

The behavior of electrons that move through a space of uniform positive charge density and satisfy Fermi statistics is examined from the point of view of wave mechanics, with emphasis placed on their mutual interactions. An analogy is established between the correlation energy of an electron gas and the polarization energy in the Debye theory of electrolytes. The charge carriers polarize their surroundings while the polarization in turn effects a saturation of the repulsion potential (from $1/r$ to $e^{-\alpha r}/r$). The results are summarized. It is shown that in such a "correlated" gas, the electrons near the boundary of the Fermi sphere exhibit a different behavior from those in the interior. They behave as though, completely unaffected by the internal electrons, they alone filled the entire volume, and their interaction gives rise to a long-range ordering relative to one another; this evokes the concept that these electrons reach their energetically most favored state when, owing to repulsion, they take on the appearance of an extended lattice in the volume through which the other, inner electrons pass, virtually without reacting. This is in complete agreement with the assumptions on which a theory of superconductivity is founded. (auth)

29490 (AEC-tr-5286) ELECTRON AND ION EMISSION. 24. SURFACE IONIZATION. 25. NEGATIVE SURFACE IONIZATION. L. N. Dobretsov. Translated by Harold G. Fox (Ames Lab., Ames, Iowa) from "Elektron-und Ionenemission" (a publication of VEB Verlag Technic, Berlin, 1954; translated from the Russian Edition dated 1952). 43p.

An analysis of electron and ion emission from incandescent metal surfaces is presented. Included are discussions and experimental data concerning surface ionization and negative surface ionization. (J.R.D.)

29491 (AEC-tr-5293) EFFECT OF HIGH PRESSURE ON THE SPECTRAL CHARACTERISTICS OF SOME CRYSTAL PHOSPHORS. J. J. Kirs and A. J. Laisaar. Translated by J. M. Christian from Proceedings of the Seventh Conference on Luminescence, Moscow, 1958. 12p.

A review is presented of a study of the effects of hydrostatic compression on some spectral characteristics of the crystal phosphors: Zn_2SiO_4—Mn and RbI—Tl. Graphical representations of the crystal phosphors are included. (B.O.G.)

29492 (JPRS-14837) SOVIET ELECTRONIC COMPUTER—THE 256-CHANNEL TIME ANALYZER WITH MEMORY UNIT. A. P. Tsitovich. Translated from Pribory i Tekh. Ekspt., No. 1, 65-77(Jan.-Feb. 1962). 29p.

The circuitry of a 256-channel time analyzer for use with time-of-flight neutron spectrometers is described. The basic memory unit is a magnetic drum which operates in a dynamic regime. The information accumulated in the channels is taken from the screen in binary or linear form by a monitor tube or in decimal form by a decatron counter. (J.R.D.)

29493 (UCRL-Trans-841) OBSERVATIONS ON MAGNETO-OPTICS. A. Cotton, H. Mouton, and J. Chaudier. Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from Compt. rend., 141: 317-19; 349-51(1905) and 142: 201-5(1906). 16p.

Results of a study concerning the magnetic-optical properties of old colloidal iron hydroxide solutions is presented which show negative birefringence. Other information is included on magnetic birefringence in new active liquids, and elliptic polarization of light produced by mixed solutions. Observations concerning occurrences in colloidal solutions in magnetic fields traversed by light parallel to the field are also included. (J.R.D.)

29494 THE EFFECT OF PLASTIC DEFORMATION ON THE ATTENUATION OF ACOUSTIC WAVES IN LITHIUM FLUORIDE CRYSTALS. D. F. Gibbons and V. G. Chirba (Bell Telephone Labs., Inc., Murray Hill, N. J.). Acta Met., 10: 484-8(Apr. 1962).

After deformations of approximately 1 per cent in compression, the attenuation of lithium fluoride shows a large peak in the neighborhood of 65°K for a frequency of 80 kc. The frequency variation of the attenuation peak position gives an activation energy of ~0.2 ev/atom. The attenuation in an undeformed crystal shows no such attenuation maximum. The position and activation energy depends upon the purity of the crystal. The maximum peak attenuation decreases with annealing at room temperature and a 5-min x-irradiation from a 50-kv 10-ma tungsten target completely removes the attenuation maximum. The possible mechanisms for this behavior are discussed. (auth)

29495 LOW TEMPERATURE INTERNAL FRICTION IN MONOCRYSTALLINE LITHIUM FLUORIDE. A. Taylor (Cornell Univ., Ithaca N. Y.). Acta Met., 10: 489-93(Apr. 1962).

The effect of room temperature plastic deformation upon the internal friction of monocrystalline bars of LiF was measured over the temperature range 20 to 273°K at 6 and 40 kc at about 1×10^{-3} strain amplitude. Slight deformation increased the over-all internal friction and gave rise to a well defined peak at about 72°K at 40 kc. Further deformation up to 5 per cent increased the height of this peak and caused the appearance of a second peak at about 160°K. Aging appeared to lower the height of the 160°K peak more rapidly than that of the lower peak, while complete annealing at 650°C removed both peaks. From the variations of the peak temperature with frequency, activation energies of approximately 0.15 ev and 0.4 ev were calculated for the 72°K peak and the 160°K peak, respectively. The present results for the 72°K peak show similarities to the Bordoni peak for copper. However, in contrast to the observations in copper, there is some evidence that the peak temperature is strongly dependent upon the concentration of impurity, and this implies that the activation energy varies with impurity concentration. (auth)

29496 PHOTOGRAPHING TRACKS IN A DIFFUSION CLOUD CHAMBER. Bert J. Hill (Central Scientific Co., Chicago). Am. J. Phys., 30: 602(Aug. 1962).

A classroom demonstration setup for photographing tracks in a diffusion cloud chamber is shown. The chamber is operated using a 45-v clearing field supplied by a 45-v dry cell, and is cooled with dry ice. Photographs are taken with a Polaroid camera, using a microscope illuminator as a light source. (T.F.H.)

29497 THE KEPLER AND RUTHERFORD PROBLEMS: A GEOMETRICAL TREATMENT. D. L. Livesey (Univ. of British Columbia, Vancouver, Can.). Am. J. Phys., 30: 629-33(Sept. 1962).

The motion of a particle in an inverse-square field of force is described in terms of the potential energy, which depends on the distance r from the center of force, and the kinetic energy, which can be expressed in terms of an effective impact parameter h. In different cases the relations between r and h correspond to paths that may be elliptic, parabolic, and hyperbolic. The results are based on elementary geometry, which is sufficient to derive Kepler's third law and the Rutherford formula for nuclear scattering of alpha particles. (auth)

29498 ON THE MOMENTUM THEOREM FOR A CONTINUOUS SYSTEM OF VARIABLE MASS. James F. Thorpe (Westinghouse Electric Corp., Pittsburgh). Am. J. Phys., 30: 637-40(Sept. 1962). (WAPD-T-1344)

Theorems of linear momentum are derived for a control system having an arbitrary motion in a continuous velocity field. The resulting equations are valid for a system of variable mass. By allowing the control system to be at rest, the equations of fluid mechanics are obtained as a special case; by allowing the control system to move with the fluid, the momentum equations for a system of constant mass are obtained as a special case. In this way, it is possible to discuss a common, but incorrect, conception of the momentum equation for a system of variable mass. (auth)

29499 THE K AUGER ELECTRON SPECTRUM OF TERBIUM. Lars Persson, Hans Ryde, and Karin Oelsner-Ryde (Nobel Inst. of Physics, Stockholm). Arkiv Fysik, 21: 193-201(1962).

The K Auger electrons emitted in the electron capture decay of Dy^{157} to Tb^{157} (Z = 65) have been studied in an iron-cored, double-focusing beta ray spectrometer. The K-LL and K-LM spectra are measured with a momentum resolution of 0.35%. The K-LL spectrum is resolved into six components interpreted as due to the $K-L_1L_1$, $K-L_1L_2$, $K-L_2L_2$, $K-L_1L_3$, $K-L_2L_3$ and $K-L_3L_3$ Auger transitions, with the following energies and relative intensities: energy (kev)—34.43, 34.88, 35.27, 35.62, 36.03, and 36.78; relative intensity—1.00, 1.69, 0.22, 1.27, 2.96, and 1.14. These experimental results are compared with the energies and the relative intensities of the K-LL Auger lines calculated by Asaad and Burhop assuming an intermediate coupling between the two inner atomic shell vacancies. The experimentally determined energies are about 0.07 kev higher than those theoretically calculated. The measured relative intensities agree fairly well with the calculated values, if these are corrected for the relativistic effects. From the experiment it is also possible to estimate the intensity ratios K-LL : K-LX : K-MX to be 1.00 : 0.48 : 0.11. (auth)

29500 FILAMENTARY STRUCTURE ASSOCIATED WITH FORCE-FREE MAGNETIC FIELDS. C. S. Murty (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 21: 203-11(1962).

The distribution of the axi-symmetric force-free magnetic fields of a helical structure is studied in the case when the ratio of the magnitude of the current density to that of the magnetic field is a function of the radial distance from the axis of symmetry. It is shown that if the system is unbounded the axial component of the current vanishes rapidly after a characteristic distance from the axis of symmetry. (auth)

29501 THE PHOTO-ELECTRON EMISSION OF X-RAYS FROM COPPER IN THE REGION AROUND THE K-ABSORPTION EDGE OF COPPER. Goesta Brogren. Arkiv Fysik, 21: 409-13(1962).

29502 THE ENERGY LEVELS OF NEUTRAL ATOMIC IODINE. Lennart Minnhagen (Univ. of Lund, Sweden). Arkiv Fysik, 21: 415-65(1962).

The analysis of the spectrum of neutral iodine has been revised and extended. The identification of strong lines as combinations between $(^3P_2)5d$ and $(^3P_2)nf$ levels with high J values, previously unknown, has given the clue to the analysis of a considerable part of the term system. The analysis is to a large extent based on theoretical energy matrix elements for $J_c l$ and $J_c j$ coupling. The following $5p^4nl$ configurations are now known, wholly or partly: 6s-12s, 6p-12p, 5d-13d, 4f-12f. The number of certain levels is about 200. The coupling conditions have been studied by means of the energy matrices. The nf configurations are almost pair coupled. The best characterization of ns is obtained by means of the $J_c l$ or $J_c j$ schemes, which are identical for ns. For np the coupling is intermediate between $J_c l$ and $J_c j$ but closer to $J_c l$. For nd the coupling conditions are not so easily studied because of the mixing of levels based on different parents and because of configuration interactions. Apparently, nd shows no simple coupling. Most levels based on $^3P_{2,1,0}$ can, however, be assigned parent levels and principal quantum numbers in addition to the J values. Pair coupling symbols have been introduced for the whole system of p^4l levels. Series perturbations have been studied and the $^3P_2$ limit accurately determined from the regular $(^3P_2)nf$ series, J = 5½ and 4½. It is 84295.1 ± 0.2 cm^{-1} above the ground level $5p^5\,^2P_{1\frac{1}{2}}$. The entire term system has been recalculated. (auth)

29503 ON THE DOPPLER PROFILES FOR AURORAL HYDROGEN EMISSION. T. F. Tuan (Air Force Cambridge Research Center, Bedford, Mass.). Astrophys. J., 136: 283-7(July 1962).

A general formula for the Doppler profile of auroral hydrogen emission along an arbitrary direction is derived. It is shown that the formula can be reduced to the usual expressions for the zenith and integrated horizon profiles, thus clarifying the relationship between these profiles. A method is also proposed with which an independent experimental determination of the angular distribution of the incident auroral protons can be made without the need of making any special assumptions about their energy spectrum. (auth)

29504 ON THE BENNETT-HULBURT HYPOTHESIS OF THE ORIGIN OF MAGNETIC STORMS AND AURORAE. V. C. A. Ferraro and D. M. Willis (Queen Mary's College, London). Astrophys. J., 136: 288-303(July 1962).

An hypothesis of electric-current-bearing solar streams as the cause of magnetic storms and aurorae is considered in the light of the argument that no appreciable current could be set up in the stream against the inhibiting influence of self-inductance. It is shown that when the collision drag on the stream ions and electrons is taken into account, the original estimate of the current—about 60 amp—must be considerably increased, but the increase is not sufficient to modify the conclusions based on the self-inductance argument. Moreover, it is shown that not all solar streams are likely to become "self-focused" by the time they reach the earth's orbit, and those that do will have densities smaller than the interplanetary density; it seems that these are likely to become unstable and lose their coherence. Finally, it is pointed out that the observed long and regular series of recurrent storms suggests that the streams cannot be greatly retarded by the interplanetary gas during their passage from the sun to the earth, if the interplanetary gas density is less than 100 particles/cc. (auth)

29505 EXPERIMENTAL MHD-GENERATOR USING COMBUSTION GASES (GAS BURNER) AS HEAT SOURCE. P. J. Nowacki, W. S. Brzozowski, and Z. Celiński (Warsaw Technical Univ.). Bull. acad. polon. sci., Sér. sci., tech., 10: 287-92(1962). (In English)

A MHD generator in which the working fluid (K_2CO_3-seeded air) is heated by being passed through an oxygen-acetylene flame is described. The electrodes in the generator are graphite and the duct walls are quartz. The description, operation, and performance of the experimental apparatus are presented. (T.F.H.)

29506 ATOMIC CHARGE STATES IN CARBON OF 10- TO 40-Mev IONS. APPLICATION TO TANDEM ACCELERATORS. E. Almqvist, C. Broude, M. A. Clark, J. A. Kuehner, and A. E. Litherland (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 954-63(Aug. 1962). (AECL-1549)

The distribution of charge states of ions of F^{19}, Cl^{35}, and Br^{79} emerging from thin carbon foils at energies of 10 to 40 Mev are measured. Atomic charges of 7, 9, and 11 electron units for the three elements respectively are produced at 10 Mev with an intensity of greater than 15% of the incident beam. These results show that a tandem accelerator with 10 Mv on the terminal can deliver good ion beams at the following energies (the values in parentheses require two-stage stripping resulting in a further reduction in beam intensity by a factor of 5 to 10): 80 Mev (95 Mev) F^{19} ions; 100 Mev (125 Mev) Cl^{35} ions; and 120 Mev (160 Mev) Br^{79} ions. The measurements show that heavy ions from a tandem accelerator can be injected into a cyclotron and stripped to give appropriate magnetic rigidity for acceleration to very high energies; for example, a 90-in. diameter magnet with a field of 14 kilogauss will yield ~½-Bev Cl or Br ions. (auth)

29507 FLUORESCENCE DECAY TIME MEASUREMENTS OF ORGANIC SCINTILLATORS. W. R. Falk and L. Katz (Univ. of Saskatchewan, Saskatoon, Can.). Can. J. Phys., 40: 978-91(Aug. 1962).

The time dependence of the fluorescence emission from scintillators is measured for a number of commonly used organic scintillators under alpha-particle and gamma-ray excitation. A sampling oscilloscope is used to record the pulses obtained from a fast scintillation counter. Using such a system, a gating arrangement can be employed that permits selection of only those scintillation events that deliver a predetermined total charge output from the photomultiplier. Noise within the sampling unit limits the measurements to the main fast components in the fluorescence emission. All of the plastic scintillators exhibit decay times between 2.1 and 4.4 nsec. Stilbene exhibits "particle type" discriminating characteristics with a strong second component in the decay (~35 nsec) appearing under alpha-particle excitation. In addition to the main component in the decay of anthracene, evidence of two shorter components is also found. For all the scintillators tested, the alpha-particle induced scintillation has a slightly longer decay time than the corresponding gamma-ray induced scintillation. (auth)

29508 THE ELECTRONIC ENERGY OF HELIUM HYDRIDE. James Clayton Browne (Univ. of Texas, Austin). Dissertation Abstr., 23: 84(July 1962).

The total energy of the He–H was computed from a wave function of the following structures: $(1s_{He} - 1s'_{He}1s_H)$, $(1s_{He} - 1s'_{He}2s_H)$, $(1s_{He} - 2s_H1s'_{He})$, $(1s_{He} - 1s'_{He}2p_{\sigma H})$, $(1s_{He} - 2p_{\sigma H}1s'_{He})$, $(1s_{He} - 1s_H2s_{He})$, $(1s_{He} - 2s_{He}1s_H)$, $(1s_{He} - 1s_H2p_{\sigma He})$, $(1s_{He} - 2p_{\sigma He}1s_H)$. The parentheses indicate a Slater determinant, the hyphen indicates spin pairing, and the 1s, 1s' are Slater orbitals. The orbital exponents were optimized for R = 5 amu and R = 3 amu. Total energies obtained were: −3.3753 amu (R = 5), −3.3576 amu (R = 3), −3.2877 amu (R = 2). Interaction energies E(R) − E(∞), were computed for all three R's. The values of E(R) − E(∞) obtained were: +0.0008 amu (R = 5), +0.0185 amu (R = 3), +0.0894 amu (R = 2). The total wave function is analyzed in terms of the so-called structure projections. The energy values were used to construct approximate analytic forms for the interaction energy and the energy differential between the ground state and the first excited state as functions of R. These were applied in a statistical model to the shift of the 1s − 2p band of the H atom spectra as a function of He pressure. A shift of +2.9 cm^{-1}/rd is predicted. (auth)

29509 THE INTERACTION OF SUBMERGED EXPLOSION BUBBLES WITH MOVABLE NON-DEFORMABLE BOUNDARIES. Jacob Burrill Gilstein (New York Univ., New York). Dissertation Abstr., 23: 266(July 1962).

An experimental investigation of the interaction of an explosively created gas bubble in a fluid with structures floating on the surface was made. The structures were constrained to either simply heave, or pitch, or flex. Several tests with each type of structure were made. For each type of structure, the mass was held constant from one test to another but the stiffness of the structure was changed by means of springs so that the natural frequency of vibration was altered. By means of supports which did not influence the flow field the structures were held at half depth on the surface in their equilibrium position. Each structure was driven by pulsating gas bubbles created by exploding wires at two different depths below the surface. The motions of the bubbles and structures were recorded by a high speed movie camera. The tests were run in a partially evacuated steel tank so that the pressure above the liquid surface was approximately one-three hundred and sixtieth of normal atmospheric pressure. This permits the simulation on a small scale of the effects caused by gravity in large scale explosions in the ocean. A theory of the coupled oscillations of a non-migrating, small amplitude pulsating, spherical bubble, in an inviscid, incompressible liquid with a simple structure floating on the surface was developed and the theoretical results are compared with the empirical data. It is concluded that gravity plays such an important role in determining the phenomena that occur, that a theory which ignores gravity is inadequate even as an approximation. (auth)

29510 EXTENDED SPACE-CHARGE THEORY IN LOW-PRESSURE THERMIONIC CONVERTERS. Robert G. McIntyre (Texas Instruments, Inc., Dallas). J. Appl. Phys., 33: 2485-9(Aug. 1962).

The problem of space-charge-limited currents in a diode with plane-parallel electrodes is considered for the case where space-charge limitations are counteracted by the introduction of ions at the cathode. The "no-collision" approximation is used, in which inelastic and short-range elastic collisions are neglected, and each particle interacts with the Coulomb field of all the other particles. The electrostatic potential is determined, in a self-consistent manner, from Poisson's equation. The equations are simplified by transforming to reduced variables. The first integrations of Poisson's equation are given for the six most important cases. Analytical solution of the first-order differential equations derived is impossible. Numerical solutions are obtained for illustrative purposes on the IBM-704 computer. (auth)

29511 MAGNETIC SUSCEPTIBILITY OF GADOLINIUM AND DYSPROSIUM SESQUIOXIDES AT ELEVATED TEMPERATURES. Sigurds Arajs and R. V. Colvin (U. S. Steel Corp. Research Center, Monroeville, Penna.). J. Appl. Phys., 33: 2517-19(Aug. 1962).

Magnetic susceptibilities of Gd_2O_3 and Dy_2O_3 are studied from about 300 to 1500°K and 300 to 1250°K respectively. The paramagnetic susceptibility data of both oxides obey the Curie-Weiss law. This information supports the suggestion that the small deviations from the Curie-Weiss law found in gadolinium and dysprosium metals result from conduction electron magnetization. The ions Gd^{3+} and Dy^{3+} in the

oxides possess the Bohr magneton numbers 7.80 and 10.52, respectively. (auth)

29512 OPTICAL MASER EMISSION FROM TRIVALENT PRASEODYMIUM IN CALCIUM TUNGSTATE. A. Yariv, S. P. S. Porto, and K. Nassau (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Appl. Phys., 33: 2519-21(Aug. 1962).

Coherent emission at 1.047 μ from trivalent praseodymium in calcium tungstate is observed. This emission coincides with strong infrared fluorescence at the same wavelength and is found to be stimulated mostly by absorption of blue light by the $^3P_0$, $^3P_1$, and $^3P_2$ bands. The emission corresponds to a $^1G_4 \rightarrow {}^3H_4$ transition with the terminal level 377 cm^{-1} from the ground state. The oscillation threshold is the same at 4.2, 20, and 78°K. No stimulated emission is observed at room temperature. The lifetime of the metastable state $^1G_4$ is 50×10^{-9} sec. A technique used to measure the lifetime is described. (auth)

29513 ELECTRON OPTICAL INVESTIGATION OF THIN FILMS OF LITHIUM ON TANTALUM, PLATINUM, AND CARBON SUBSTRATES. A. L. Esquivel, Ai-Chun Fung, H. U. Rhoads, and A. H. Weber (St. Louis Univ.). J. Appl. Phys., 33: 2613-18(Aug. 1962).

Thin films of lithium when evaporated onto well-polished, chemically cleaned, and outgassed Ta and Pt substrates form uniformly thick layers (in the range 240 to 1600 Å) suitable for the (p-n) reaction in the Van de Graaff generator. A thin carbon coating (about 300 Å thick), evaporated upon the Li film from a heated carbon filament immediately following the deposition of lithium on Ta and Pt substrates, chemically insulates the lithium from the air with its water vapor content and also provides carbon replicas of the Li film surface for electron microscopy. Proton bombardment of the carbon-coated Li films has no visible effect on the carbon coating nor on the Ta or Pt substrate. However, after a proton beam bombardment of 10 μA-min at 1.88 Mev, the Li films show evidence of some initial damage effect (growth of grain size plus surface unevenness), which appears to anneal away with subsequent bombardment. Orientation effects are observed in Li films deposited upon carbon substrates (in turn deposited on nickel mesh grids) in a special evaporator, attached to and forming a part of the vacuum system of an electron microscope (RCA type EMU-2B) in order to avoid contamination of the Li with the laboratory atmosphere. Electron diffraction patterns reveal the following: random orientation for the thinner (240 Å, approximately) Li films; and preferred orientation of the (110) and (200) planes nearly perpendicular to the surface for the thicker (1600 Å, approximately) films. (auth)

29514 TRANSITION RADIATION WITH A FINITE PLATE. P. Parzen and G. Nomicos (Republic Aviation Corp., Farmingdale, N. Y.). J. Appl. Phys., 33: 2640-2 (Aug. 1962).

The transition radiation resulting from a modulated infinite electron beam passing through a finite infinitely conducting circular plate is computed. Numerical results are worked out for various ratios of plate radius to wavelength with a 300-Mev electron beam. These results compare favorably with an approximate expression derived. (auth)

29515 ORIGIN OF THE OSCILLATIONS IN A LOW-PRESSURE THERMIONIC CONVERTER. Paul Mazur (Avco Corp., Wilmington, Mass.). J. Appl. Phys., 33: 2653(Aug. 1962).

Several formulations of the Poisson-Vlasov equation are used to describe the spatial behavior of the electrostatic potential in a low-pressure, gas-filled, plane-parallel-diode thermionic cell. From the shapes of the potential curves obtained, it is surmised that there exists a region of the current-voltage (I-V) characteristic where stationary states (i.e., solutions to the Vlasov equation) do not exist. Further, that I-V region in which stationary states are nonexistent coincides with the region in which oscillations are observed. (T.F.H.)

29516 RETENTION OF KRYPTON-85 TRAPPED DURING POSITIVE ION BOMBARDMENT. H. M. DeAngelis (Air Force Cambridge Research Labs., Bedford, Mass.). J. Appl. Phys., 33: 2657-8(Aug. 1962).

Samples of Ge, Si, Ni, and Pt are placed in an electric discharge in Kr (1 at.% Kr^{85}) at 1 to 2 μHg. The discharge has parameters V = 1 kv, I = 0.1 amp, and J = 0.5 ma/cm^2. The samples all become saturated with Kr within about 5 sec. The Kr saturation concentrations in the samples are determined. The effect of subsequent vacuum annealing at 400°C on the Kr content is studied as a function of annealing time, for the Ni and Si samples. (T.F.H.)

29517 ELECTRICAL PROPERTIES OF HEAVILY DOPED NIOBIUM PENTOXIDE. R. Valetta (American Machine and Foundry Co., Springdale, Conn.). J. Chem. Phys., 37: 67-71(July 1, 1962).

An analysis of the resistivity and thermoelectric power of heavily doped Nb_2O_5 [over-all composition $(Nb_{1-x}W_x)_2O_5$ where x varies from 0.0025 to 0.15] shows that mixed valence semiconduction has been observed. The major factor determining the value of the thermoelectric power at high temperatures appears to be an entropy of mixing term. In samples with $x > 0.10$, it is concluded that the electrons can be trapped on tungsten ions as well as niobium ions. The low-temperature resistivity data indicate that the conduction mechanism is not simply described at temperatures where the tungsten impurity ions are incompletely ionized. (auth)

29518 KINETICS OF Cs^+ DESORPTION FROM TUNGSTEN. Milton D. Scheer and Joseph Fine (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 37: 107-13(July 1, 1962).

The mean adsorption lifetime τ_3 of Cs^+ on tungsten was measured in the 1000 to 1200°K temperature range, using a pulsed beam technique. Under conditions of low surface coverage and with either Cs or CsI as beam materials, $\tau_3 = (1.0 \pm 0.5) \times 10^{-12} \exp[(23{,}600 \pm 500)/T]$ sec was obtained. The heat of desorption can be calculated as the energy required to remove an isolated Cs^+ ion from the surface of an electrical conductor. The presence of an adsorbed contaminating layer, arising from residual vacuum gases, decreased the Cs^+–W binding energy by 0.5 ev and increased the pre-exponential factor by about two orders of magnitude. Anomalous results were obtained when CsCl was used for a beam material, suggesting a reaction between the surface tungsten atoms and atomic chlorine. (auth)

29519 PROTON MAGNETIC RESONANCE SPECTRUM OF HDO. John R. Holmes, Daniel Kivelson, and William C. Drinkard (Univ. of California, Los Angeles). J. Chem. Phys., 37: 150-2(July 1, 1962).

The proton magnetic resonance spectrum of the distinct species HDO was observed in dilute solutions of H_2O and D_2O in carefully purified organic solvents. The HDO triplet is centered 0.030 ± 0.003 ppm upfield from the H_2O resonance. The proton-deuteron spin–spin coupling constant A_{HD} is 1.1 ± 0.1 cps. Approximate theories which provide explanations for the coupling constant and chemical shift are discussed. (auth)

29520 POTENTIAL CURVES FOR BeH^+ AND CH^+. Shirley M. Read (Univ. of Maryland, College Park), Joseph T. Vanderslice, and František Jenč. J. Chem. Phys., 37: 205-6(July 1, 1962).

The Rydberg-Klein-Rees (RKR) method for obtaining potential curves directly from spectroscopic data was used to calculate potential curves for the $X^1\Sigma^+$ and $A^1\Sigma^+$ states of BeH^+ and the $A^1\pi$ state of CH^+. The RKR results for the $X^1\Sigma^+$ state of BeH^+ are compared with recent quantum calculations based on seven-term configuration interaction. (D.L.C.)

29521 PARAMAGNETIC TERM OF THE SUSCEPTIBILITY AND ITS SHIFT WITH ISOTOPE IN LiF. Allan M. Russell (Univ. of California, Riverside). J. Chem. Phys., 37: 214-16(July 15, 1962).

The rotational magnetic moments μ_J/J were measured for Li^6F and Li^7F in the same magnetic field. These measurements, when combined with the experimental value of μ_e^2A for Li^6F, yield a value for the internuclear distance which disagrees with the value obtained from vibrational spectra. It is proposed that the discrepancy is due to an error in assuming that the high-frequency or paramagnetic term χ^{HF} in the magnetic susceptibility is the same for each isotopic species. If the internuclear distances calculated from infrared spectra are assumed to be correct, the high-frequency term is found to be $\chi^{HF} = 1.25 \pm 0.02 \times 10^{-6}$ erg G^{-2} $mole^{-1}$. The isotopic shift $\Delta\chi^{HF}$ is calculated separately and found to be $\Delta\chi^{HF} = 5.0 \pm 0.5 \times 10^{-8}$ erg G^{-2} $mole^{-1}$. This represents a decrease of 0.4% from Li^6F to Li^7F. A calculation of the electric dipole moment of Li^6F from the same data yields $\mu_e = 6.40 \pm 0.04$ D ($v = 0$). (auth)

29522 ROTATIONAL FREEDOM OF AMMONIUM IONS AND METHYL GROUPS BY CROSS-SECTION MEASUREMENTS WITH SLOW NEUTRONS. J. J. Rush, T. I. Taylor, and W. W. Havens, Jr. (Columbia Univ. New York and Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 37: 234-8(July 15, 1962). (BNL-5979)

The slope $\Delta\sigma_s/\Delta\lambda_n$ of a plot of the scattering cross section per proton vs the wavelength of subthermal neutrons is shown to increase with increasing freedom of rotation of ammonium ions. For ammonium iodide, the slope increases from 6.2 b/Å—H in phase II to 11.2 b/Å—H in phase I, where the ammonium ions are rotating relatively freely. Measurements on five liquid methylbenzenes indicate greater hindrance to rotation of methyl groups in o-xylene (slope = 9.5 ± 0.3 b/Å—H), than in toluene, m-xylene, p-xylene, and mesitylene (slopes = 11.4 ± 0.3 b/Å—H). From an empirical plot of slopes vs barriers to rotation of ammonium ions in several ammonium salts, slopes of 5.5 and 5.8 b/Å—H for $(NH_4)_2CrO_4$ and NH_4CNS indicate a barrier of about 4 kcal $mole^{-1}$ for both these salts, while a high slope of 13 b/Å—H for NH_4ClO_4 predicts a barrier of only about 0.1 to 0.2 kcal $mole^{-1}$. Assuming a similar type curve for methyl groups, the barrier to rotation of the methyl groups in o-xylene is estimated to be about 1 kcal $mole^{-1}$, and a value of 0.1 to 0.4 kcal $mole^{-1}$ is predicted for the other methylbenzenes. (auth)

29523 MAGNETIC SHIELDING IN SOME DIATOMIC MOLECULES. C. William Kern and William N. Lipscomb (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 37: 260-6(July 15, 1962).

Magnetic shielding constants calculated for all nuclei in LiH, BH, NH, BF, HF, LiF, CO, H_2, Li_2, N_2, and F_2 have yielded good results for lighter nuclei bonded to heavier nuclei. The difficult paramagnetic contribution of Ramsey's theory is reduced to tractable terms involving only the ground-state wave function by a choice of the gauge of the vector potential and by an approximation involving cancellation of average excitation energies of matrix elements depending upon angular momentum and linear momentum operators. The limitations of this approximation are explored. (auth)

29524 STARK EFFECT IN HYDROGEN. E. Steiner (Univ. of Edinburgh, Scotland). J. Chem. Phys., 37: 454-5 (July 15, 1962).

A method is given for evaluating the second-order energy term E'' in the energy for the atom in an electric field F, $E(F) = E_1^0 + FE' + F^2E'' + \ldots$, where $E_1^0 = -\frac{1}{2}$ and $E' = 0$. The method reduces the problem to one of evaluating only one term by means of a choice of the basis set $L_{n+1}^{2l+2}(2r)$. E'' is found to be $-\frac{9}{4}$, and the polarizability of the hydrogen atom in its ground state is $-\frac{1}{2}$ E'' = $\frac{9}{2}$. The wave function for the perturbed system is, to order F, $\psi = \psi_{100}^0[1 - Fz(1 + r/2)]$. (D.L.C.)

29525 ELECTRON PRECIPITATION ACCOMPANYING IONOSPHERIC CURRENT SYSTEMS IN THE AURORAL ZONE. J. R. Barcus and R. R. Brown (Univ. of Calif., Berkeley). J. Geophys. Research, 67: 2673-80(July 1962).

From examination of x-ray and ionospheric absorption data during magnetic bays in the auroral zone, it is found that electron precipitation on the atmosphere accompanies auroral-zone electrojets. The position of an electrojet and its associated electron precipitation region, rather than the amount of current in the system, largely controls the magnitude of x-ray and ionospheric absorption effects. (auth)

29526 A COMPARISON OF AURORAL-ZONE X-RAY OBSERVATIONS FROM PERIODS WITH DIFFERENT LEVELS OF SOLAR ACTIVITY. R. R. Brown (Univ. of California, Berkeley). J. Geophys. Research, 67: 2681-4 (July 1962).

A comparison is made of auroral-zone x-ray observations from balloon flights in the summer months of 1960 and 1961, to examine how electron precipitation varies with solar activity. The results indicate that the frequency of x-ray events diminishes with a decline in solar activity. However, the daily electron flux over the auroral zone in June 1961 is twice as large as that in 1960. This result is attributed to position-motion effects of the electron precipitation. (auth)

29527 TIME, HEIGHT, AND LATITUDE DISTRIBUTION OF D LAYERS IN THE SUBAURORAL ZONE AND THEIR RELATION TO GEOMAGNETIC ACTIVITY AND AURORA. Arne Pedersen (Research Institute of National Defense, Uppsala). J. Geophys. Research, 67: 2685-94 (July 1962).

Echoes from the D region are obtained during disturbed periods with sweep-frequency ionosondes at stations in the northern part of Swedea. Typical D-layer situations are described, and the time and height distribution of D layers is shown for one of the stations in the subauroral zone. Arguments are advanced in support of the hypothesis that these D layers are caused by precipitation of energetic electrons from the outer Van Allen belt. (auth)

29528 CORPUSCULAR HEATING OF THE UPPER ATMOSPHERE. H. K. Paetzold (Univ. of Cologne). J. Geophys. Research, 67: 2741-4(July 1962).

Analysis of the density and temperatature variations in the solar cycle gives evidence that a considerable heating of the upper atmosphere is caused by the interplanetary plasma (the solar wind). Two-thirds of the energy influx originates from the solar short ultraviolet radiation, and one-third from the interplanetary corpuscles. Both energy fluxes strongly decrease toward the sunspot minimum. On the basis of the observed temperature variations with semi-

annual and annual period, it must be concluded that the intensity of the corpuscular heating periodically varies along the earth's orbit around the sun. (auth)

29529 VERY-LOW-FREQUENCY EFFECTS FROM THE NOVEMBER 10, 1961, POLAR-CAP ABSORPTION EVENT. Howard F. Bates (Univ. of Alaska, College). J. Geophys. Research, 67: 2745-51(July 1962).

A weak polar-cap absorption event began on November 10, 1961. It profoundly affected the polar Rugby, UK, to College, Alaska, VLF path. Twenty minutes after the observation of the solar flare believed responsible, the 16.0-kc Rugby signal shifted phase approximately 250° and amplitude −20 db over a 1-hour period. During the event the diurnal variations of phase and amplitude increased in magnitude and changed markedly from normal patterns. The effective height of the VLF wave guide over the polar cap dropped to about 5 km below the normal D-region height even though much of the path was completely dark. Over most of the path the reflection height was below that for the normal, sunlit D region, but the signal amplitude was significantly greater than that when the entire path was sunlit. The proton bombardment apparently lasted for at least 5 days after the onset of the event. (auth)

29530 SPUTTERING BY 20-Kev Ar^+ IONS AT NORMAL INCIDENCE ON METEORITES. D. Heymann and J. M. Fluit (F.O.M. Lab. of Mass-Separation, Amsterdam). J. Geophys. Research, 67: 2921-4(July 1962).

Information on space erosion of meteorites is gathered from exposure ages of iron meteorites. Meteorite targets are bombarded with 20-kev Ar^+ ions in an isotope separator. The results show that the iron meteorite Canyon Diabolo erodes faster than the stone meteorites Arapahoe and Richardton. The rates of erosion are 2, 1.4, and 1.2 mg/coulomb, respectively. It is shown that ions heavier than helium ions account for only a small fraction of space erosion by ions. However, erosion by helium ions may be comparable to erosion by protons. The experimental results seem to indicate that space erosion by ion bombardment cannot explain large differences in exposure ages of iron and stone meteorites. (auth)

29531 DEPENDENCE OF INTERVAL BETWEEN FLARE AND ASSOCIATED SUDDEN COMMENCEMENT STORM ON PRESTORM CONDITIONS. M. W. Haurwitz (National Bureau of Standards, Boulder, Colo.). J. Geophys. Research, 67: 2979-82(July 1962).

The time interval (Δt) between a sudden-commencement-causing (SC-causing) solar flare and its associated SC is studied as a function of several factors: the magnetic disturbance level during the three-day period preceding the SC; successive flares in the same region; and the position of the flare (eastern or western limb). A tendency is found for SC's preceded by a high level of magnetic activity to have short Δt's, and for SC's preceded by a low level of magnetic activity to have either short or long Δt's. The statistics (54 flares) are inadequate to determine the effects of successive flares in the same region on Δt. An excess of short-Δt western-limb flares is observed, which could, however, occur by chance with a probability of about 0.1. (T.F.H.)

29532 ON THE CHOICE OF CONDITION TO APPLY AT THE BOUNDARY OF THE GEOMAGNETIC FIELD IN THE STEADY-STATE CHAPMAN FERRARO PROBLEM. John R. Spreiter and Benjamin R. Briggs (National Aeronautics and Space Administration, Moffett Field, Calif.). J. Geophys. Research, 67: 2983-5(July 1962).

An analysis is made of the conditions prevailing when the earth is deeply immersed in a neutral ionized cloud, assuming that a steady state is established in which particles incident on the boundary of the earth's magnetic field are specularly reflected. Since the number of specularly reflected particles is exactly equal to the number of particles in the incident stream in the steady state, the number density of particles in the vicinity of the magnetic field boundary is exactly twice that associated with the incident stream alone. It is concluded from these considerations that in the equation $H^2/8\pi = KmnU^2$, in which m, n, and U are the mass, number density, and normal velocity component of the protons in the incident stream at the boundary of the geomagnetic field whose strength is H, the value of the coefficient K should be taken as 2. The consequences of this choice are discussed. (T.F.H.)

29533 ENERGY CONVERSION BY JET OF IONIZED VAPOR. M. Surdin (Centre d'Études Nucléaires, Saclay, France). J. phys. radium, 23: 297-8(May 1962). (In French)

A theory of S. Klein's experiment on direct conversion of energy by an ionized vapor stream is given. The negative potential of the hot electrode is calculated assuming that electrons and ions obey a Maxwell-Boltzmann distribution. The positive potential of the cold electrode is calculated in the same manner. The negative charge carriers arriving at the cold electrode are water droplets. The short-circuit current is calculated, approximately, assuming that the electron short-circuit current compensates the ion current arriving at the cold electrode. (auth)

29534 THE THEORY OF HELIUM II. Lesser Blum (Facultad de Ciencias Exactas y Naturales, Buenos Aires). J. phys. radium, 23: 305-7(May 1962). (In French)

A method of summation of evolution diagrams is applied to the hamiltonian giving the phonon spectrum in liquid helium. It is pointed out that, in this case, the entropy variation is always zero. (auth)

29535 THE THEORY OF THE SUPERFLUID STATE. Jacques Winter. J. phys. radium, 23: 323-6(May 1962). (In French)

An interpretation of London's theory is given. The superfluid should be formed of unlocalized helium atoms, with the same wave functions. Facts which this theory can explain easily are absence of viscosity, thermomechanical effect, and, especially, the critical speed of Rollin films. (auth)

29536 SOME EXPERIMENTS ON THE TURBULENCE AND MUTUAL FRICTION IN LIQUID HELIUM. H. C. Kramers (Kamerlingh Onnes Laboratorium, Leiden). J. phys. radium, 23: 326-32(May 1962). (In French)

Recent experiments on the hydrodynamic properties of liquid helium II, performed in the Kamerlingh Onnes Laboratorium (Leiden), are discussed on the basis of the two-fluid model. Staas and Taconis measured temperature and pressure gradients occurring in a narrow circular capillary in the presence of a heat current. They discovered a turbulent phenomenon, very analogous to ordinary classical turbulence. The attenuation of second sound was studied by Wiarda and the present author in its dependence on a simultaneous continuous heat current. The method employed proves to be very suitable for a study of the so-called mutual friction and of phenomena occurring in the critical velocity region. (auth)

29537 USE OF A COINCIDENCE SYSTEM IN THE SELECTIVE DETERMINATION OF ATMOSPHERIC RADON AND THORON. Jacques Fontan, Daniel Blanc, and André Bouville (Centre de Physique Nucleaire, Faculte des Sciences, Toulouse). J. phys. radium, 23: 333-4(May 1962). (In French)

A procedure for the separation of the activity of thoron daughters from those of radon consists of placing in coincidence the β particle of ThC with the α particle of ThC′. This method was applied to the natural radioactivity of the atmosphere by associating the method with a coincidence apparatus which is sketched. The proportion of the ThC-ThC′ and RaC-RaC′ coincidences as a function of the time resolution of the selector was determined. The sensitivity of the apparatus depends on the radon background. The results showed that equilibrium between thoron and its descendants is never realized. The reason for this lack of equilibrium is discussed. (J.S.R.)

29538 NATURAL CONSTANTS. Samuel C. Horning. Nature, 195: 587-9(Aug. 11, 1962).

Discussion is given on locating equal functions of natural constants by empirical methods. Examples given are constants related to forces and relatively simple functions of a (the fine structure constant) and π which are nearly equal numerically to the constants when $C = \hbar = \lambda_e = 1$, and elementary particles and functions of a and 2π nearly equal to particle masses. It is concluded that it may be possible to reduce the number of basic natural constants by locating exact relations between constants using dimensional units defined by three natural constants. Since a and π seem most likely to represent the ultimate basic numbers it is suggested that it might prove useful to examine all simple functions of a and π nearly equal to natural constants to determine if a logical set of functions exists which will include all constants. (P.C.H.)

29539 CONDUCTIVITY OF PHOTOGRAPHIC EMULSIONS. J. Beneš (Nuclear Research Inst., Prague), A. Fořt, and K. Vacek. Nature, 195: 895-6(Sept. 1, 1962).

The connection between the photochemical sensitivity and the photoconductivity was examined for several types of photographic emulsions. The ratio of conductivity in dark to conductivity upon illumination was found to be 6 for Foma (17/10 DIN), 2.3 for Dia U Foma (3° Sch.), 3 for Au-sensitized nuclear emulsion, 0.86 for unsensitized nuclear emulsion, and 0.47 for single AgCl crystals. The higher conductivity ratios were found to correspond with high sensitivities, and the result is explained in this way: Sensitive materials contain high concentrations of deep trapping centers which trap the free photoelectrons and neutralize interstitial Ag^+ ions, thus decreasing the conductivity upon being illuminated. (D.L.C.)

29540 STUDY ON THE DISTORTION IN NIKFI-R-EMULSION-II. PART II. INFLUENCE OF DRYING METHODS. I. Hauser (Zentralinstitut für Kernphysik, Rossendorf b. Dresden), H. Engelhardt, U. Kreckler, and K. Lanius. Nuclear Instr. & Methods, 16: 113-15(June 1962). (In German)

In order to investigate the distortion resulting from different drying methods, NIKFI-R nuclear emulsions were soaked in various series of alcohol-water solutions after washing and then air dried. The distortions were measured by means of the method of Cosyns and Vanderhaeghe. The various conditions of drying investigated had no influence on the distortions except those near the edges in air dried emulsions. It was suggested that the distortions might be caused by processes preceding the development procedure. (auth)

29541 RANGE-ENERGY RELATIONSHIP OF CHARGED PARTICLES IN SILICON. William L. Weiss and Ella Mae Whatley (Oak Ridge Technical Enterprises Corp., Tenn.). Nucleonics, 20: No. 8, 147-8(Aug. 1962).

Graphs and nomographs are presented to assist in choosing the proper Si charged-particle detector for a particular application. The two nomographs are range-energy for protons, deuterons, tritons, He^3, and alphas, and Si resistivity-depletion(or capacitance)-detector bias. The graphs are beta energy vs range in Si, and specific energy loss vs energy for electrons and protons. (D.L.C.)

29542 HYPERFINE STRUCTURE OF THE INVERSION LINE J = 6, K = 6, OF $N^{14}D_3$. V. S. Zuev. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 358 (May 1962).

A maser with a $N^{14}D_3$ beam was used to observe the hyperfine structure of the inversion transition J = 6, K = 6. The line of frequency 1656.18 Mc is split into five components by interaction of the N nucleus with the molecular field, and the lines for $F_1 \rightarrow F_1'$ transitions are also split due to the deuteron nuclear moments. Graphs of the spectrum are given for both the low- and high-frequency sides of the central line, with the separations from the central line given in kc. (D.L.C.)

29543 HEAT CONDUCTION BY LIQUID HELIUM II IN CAPILLARY TUBES. III. MUTUAL FRICTION. D. F. Brewer and D. O. Edwards (Clarendon Lab., Oxford). Phil. Mag. (8), 7: 721-35(May 1962).

Measurements are described of the stable supercritical thermal resistance of liquid helium II between 1.2 and 2.0°K in capillary tubes of diameter 52, 107.6, and 366 microns. The results are presented in terms of the quantized vortex line theory, and values of L_0, the effective length of vortex line per unit volume, are calculated. Graphs of $L_0^{\frac{1}{2}}$ against relative velocity v are straight lines at high velocities, corresponding to a cube law of mutual friction of the form $F_{sn} = A\rho_s\rho_n v(v - v_0)^2$. Values of A are independent of tube diameter and length, and increase with temperature. At low velocities, where the average spacing of vortex lines becomes comparable with the channel width, the effective value of A drops rather abruptly by about one-half. In this region, theory can no longer be expected to apply, but a plot of the dimensionless variables $(DL_0^{\frac{1}{2}})$ against $(mvD/\hbar)$ (where D is the ratio of area to perimeter of the channel) gives approximately a universal curve for all tube sizes at a given temperature, as may be expected from a dimensional analysis. (auth)

29544 ON THE TRANSPORT EQUATION FOR ELECTRONS IN SOLIDS. V. Heine (Cavendish Lab., Cambridge, Eng.). Phil. Mag.,(8), 7: 775-81(May 1962).

In the theory of a Fermi liquid the transport equation introduced intuitively does not possess a fundamental justification. It is shown here that the transport equation for electrons may be integrated to give the macroscopic equations of energy and entropy balance. This serves to justify its use and also indicates the correct generalization of the theory to the non-isotropic situation of electrons in solids. (auth)

29545 MÖSSBAUER EFFECT ISOMER SHIFT OF Fe^{57} IN SILICON AND GERMANIUM. P. C. Norem and G. K. Wertheim (Bell Telephone Labs., Inc., Murray Hill, N. J.). Phys. and Chem. Solids, 23: 1111-18(Aug. 1962). (In English)

The Mössbauer spectra of Fe^{57} in n- and p-type silicon and germanium were studied. In silicon, iron produced by the decay of cobalt has a dominant, unsplit absorption at -0.0012 ± 0.0003 cm/sec Doppler velocity relative to potassium ferrocyanide. No difference in isomer shift was observed between n- and p-type silicon, indicating that the iron tested was electrically inactive. The spectrum of substitutional Fe^{57} was identified with an absorption at $+0.054 \pm 0.004$ cm/sec showing less than 3 Mc/sec electric quadrupole splitting. The spectrum of iron produced by

the decay of cobalt in germanium is a doublet with an isomer shift of +0.036 ± 0.001 cm/sec and with a quadrupole splitting of 5 Mc/sec. It is assumed that this splitting is due to the asymmetrical positions of the Fe^0 and Fe^{4-} atoms in the germanium lattice. No differences in isomer shift or quadrupole splitting were observed between iron in n- and p-type germanium, indicating that the iron is electrically inactive. (auth)

29546 INTERSTITIAL IONS AS ACTIVE DEFECTS IN THERMAL CONDUCTION EXPERIMENTS ON KCl AND KBr-SINGLE CRYSTALS. W. Gebhardt (Technische Hochschule, Stuttgart). Phys. and Chem. Solids, 23: 1123-34 (Aug. 1962). (In German)

A description of an experimental chamber is given in which optical absorption and thermal conductivity measurements, as well as uv- and x-irradiations, were performed in the temperature range from 1·8 to 22°K. With this arrangement, two photochemical reactions in KBr single crystals were investigated: (1) X-irradiation at 5°K produces essentially anion vacancies and probably interstitial ions as "anticenters"; (2) uv-irradiation of the system KBr + KH in the spectral range of the U-band bleaches this absorption and causes the formation of anion vacancies and the occupation of interstitial sites by H^- ions. With the first reaction, a strong increase of thermal resistivity was obtained which may be understood as an effect of phonon scattering by interstitial ions. The order of magnitude of the phonon scattering cross section was estimated to be 10^{-15} cm^2 at 3.3°K. The thermal conductivity is still sensitive to a defect concentration of $c > 10^{-7}$. The stability of these interstitial ions was tested by annealing. The effects due to optical bleaching of the U-band are one order of magnitude smaller than the effects caused by x-irradiation of the pure crystals. Similar results for both reactions were obtained from KCl single crystals. The temperature dependence of thermal resistivity of irradiated crystals deviates from that expected from a pure Rayleigh scattering. (auth)

29547 ELECTRON BOMBARDMENT CONDUCTIVITY IN ZINC SULPHIDE. W. Ehrenberg and N. J. Hidden (Univ. of London). Phys. and Chem. Solids, 23: 1135-45 (Aug. 1962). (In English)

The conductivity induced by bombardment with cathode rays in vacuum-deposited films of zinc sulfide and in plates of wurtzite crystals is studied. Both types of specimens respond strongly to steady bombardment and to short bursts, the films responding to steady bombardment only if the energy of the cathode rays exceeds a threshold value, the crystals only if the bias is high enough. The theory of the effect is discussed. (auth)

29548 SOUND ABSORPTION IN LIQUID HELIUM II, T < 0.5°K. Truman O. Woodruff (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 127: 682-5 (Aug. 1, 1962).

The expression $\Gamma = A\Omega T^4/\rho c_0^3$ for the absorption of sound in liquid He^4 II for T < 0.5°K, where T is the absolute temperature, is shown to be a simple consequence of the principles of the excitation theory of a Bose liquid and a few other reasonable postulates. (Γ is the absorption, $\Omega/2\pi$ is the frequency and c_0 the velocity of the sound, and ρ is the density.) As in the work of Woodruff and Ehrenreich on sound absorption in insulating crystals, the analysis is based on the linearized Boltzmann transport equation and the Blount formula for the energy loss from a system of interacting excitations driven by a sound wave. It is valid for frequencies such that $\Omega\tau \gg 1$ and $\Omega \ll KT/\hbar$, where τ is the relaxation time for the thermal phonons and K is Boltzmann's constant. The coefficient A is related to the rate of change of the sound velocity with density. An attempt is made to determine the exact magnitude of A within the framework of the present considerations by postulating a relative motion of the normal and superfluid components, but this approach leads to new difficulties. (auth)

29549 ELECTRON PARAMAGNETIC RESONANCE OF TRIVALENT GADOLINIUM IONS IN STRONTIUM AND BARIUM TITANATES. L. Rimai and G. A. deMars (Raytheon Co., Waltham, Mass.). Phys. Rev., 127: 702-10 (Aug. 1, 1962).

Electron paramagnetic resonance data of substitutional Gd^{3+} impurities in the cubic and tetragonal phases of barium and strontium titanates are reported. The pertinent spin Hamiltonian parameters are determined as a function of temperature in these two mentioned phases of both crystals. The temperature for the cubic-to-tetragonal phase transition in $SrTiO_3$ is determined from these data to be 110 ± 2.5°K, a result that has been checked by the observation of the temperature dependence of the birefringence pattern of pure (undoped) crystals. This experiment is also briefly described. In the latter crystal a smooth transition is found, contrary to the corresponding case in $BaTiO_3$. The Gd^{3+} resonance results are compared with previous data on electron paramagnetic resonance of iron-group impurities, and some comments and conjectures are offered as to possible correlation of these results with the temperature dependence of certain properties of the host crystals in the neighborhood of the phase transition. (auth)

29550 NEUTRON-DIFFRACTION STUDY OF ANTIFERROMAGNETIC $FeCl_3$. J. W. Cable, M. K. Wilkinson, E. O. Wollan, and W. C. Koehler (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 714-17(Aug. 1, 1962).

Neutron diffraction measurements were made on polycrystalline and single-crystal samples of anhydrous $FeCl_3$ at sample temperatures from 298 to 1.3°K. Antiferromagnetic reflections were observed which indicate a complicated magnetic structure with a Néel temperature of 15 ± 2°K. In this structure the magnetic moments of nearneighbor atoms in the c-axis direction are oppositely oriented, but superimposed on this order there is a modulation of the moment distribution in the $[14\bar{3}0]$ direction. From the absence of satellite reflections other than first order and from the relative intensities of the first order satellites, it is concluded that the modulation is of the helical type in which the moments lie within $(14\bar{3}0)$ planes and rotate by $2\pi/15$ in successive planes along the $[14\bar{3}0]$ direction. Absolute intensity measurements yield a moment of $(4.3 \pm 0.4)\mu_B$ per Fe^{+3} ion, and indicate a slight distortion of the helix. (auth)

29551 ENERGY LEVELS OF DIVALENT THULIUM IN CaF_2. Zoltan J. Kiss (RCA Labs., Princeton, N. J.). Phys. Rev., 127: 718-24(Aug. 1, 1962).

From the fluorescence and absorption spectra of $CaF_2:Tm^{2+}$ an energy-level scheme for the system is proposed. The cubic-crystal-field parameters are determined, and evidence is presented that the f−f transitions are of magnetic-dipole origin. A fluorescent band is observed that appears to originate in closely coupled Tm^{3+}–Tm^{3+} pairs. The large crystal-field splitting in $CaF_2:Tm^{2+}$ is confirmed by the absorption spectra of its isoelectronic systems of $CaF_2:Yb^{3+}$ and $CaF_2:Ce^{3+}$. (auth)

29552 NUCLEAR MAGNETIC RESONANCE IN CUBIC SODIUM TUNGSTEN BRONZES. Albert Narath and Duane C. Wallace (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev., 127: 724-9(Aug. 1, 1962).

choosing the proper Si charged-particle detector for a

quadrupole splitting. The spectrum of iron produced by

The nuclear magnetic resonances of W^{183} (natural abundance) have been studied in samples of cubic sodium tungsten bronzes (Na_xWO_3) with x ranging from 0.56 to 0.89, in tungsten trioxide, and in tungsten metal. The bronze resonances exhibit appreciable diamagnetic shifts (~0.3%) with respect to tungsten trioxide, the shift increasing with increasing x. The spin-lattice relaxation time for Na^{23} in $Na_{0.89}WO_3$ was found to be 55 sec. These results provide evidence that the conduction band in the cubic sodium tungsten bronzes is based on tungsten 5d states. (auth)

29553 THEORY OF LOW-TEMPERATURE IMPACT IONIZATION IN HIGH-PURITY GERMANIUM. A. Zylbersztejn (Laboratoire de Physique de l'Ecole Normale Supérieure, Paris). Phys. Rev., 127: 744-9 (Aug. 1, 1962).

An analysis of low-temperature electrical breakdown of semiconductors shows that the main theoretical problem is to find the distribution function $f(\epsilon,E)$ of the charge carriers, depending on the applied electric field E. In the case of high-purity n-type germanium ($N_D + N_A < 4 \times 10^{13}$ cm^{-3}), it is shown that the only important interactions are the electron-acoustical phonon ones. The distribution function has been calculated under equivalent assumptions by Stratton. It is used in order to find the rates of creation and recombination of the charge carriers. Direct radiative recombination is found to be negligible; and the prebreakdown characteristics are mainly governed by the decrease of the thermal recombination rate. The impact ionization rate is calculated under the simplifying assumption of a cross section independent of the energy, thus introducing the only adjustable parameter. The breakdown field dependence on both temperature and compensation of the material is obtained. The results are compared with the data of Koenig and Brown. The agreement is found to be satisfactory. Conclusions to be drawn from this agreement are discussed, together with the limitations introduced by the chosen models. (auth)

29554 OPTICAL ABSORPTION INTENSITIES OF RARE-EARTH IONS. B. R. Judd (Univ. of California, Berkeley). Phys. Rev., 127: 750-61(Aug. 1, 1962). (UCRL-10019)

Electric dipole transitions within the 4f shell of a rare-earth ion are permitted if the surroundings of the ion are such that its nucleus is not situated at a center of inversion. An expression is found for the oscillator strength of a transition between two states of the ground configuration $4f^N$, on the assumption that the levels of each excited configuration of the type $4f^N n'd$ or $4f^N n'g$ extend over an energy range small as compared to the energy of the configuration above the ground configuration. On summing over all transitions between the components of the ground level ψ_J and those of an excited level $\psi'_{J'}$, both of $4f^N$, the oscillator strength P corresponding to the transition $\psi_J \rightarrow \psi'_{J'}$ of frequency ν is found to be given by $P = \Sigma T_\lambda \nu(\psi_J||U^{(\lambda)}||\psi'_{J'})^2$, where $U^{(\lambda)}$ is a tensor operator of rank λ, and the sum runs over the three values 2, 4, and 6 of λ. Transitions that also involve changes in the vibrational modes of the complex comprising a rare-earth ion and its surroundings, provide a contribution to P of precisely similar form. It is shown that sets of parameters T_λ can be chosen to give a good fit with the experimental data on aqueous solutions of $NdCl_3$ and $ErCl_3$. A calculation on the basis of a model, in which the first hydration layer of the rare-earth ion does not possess a center of symmetry, leads to parameters T_λ that are smaller than those observed for Nd^{3+} and Er^{3+} by factors of 2 and 8, respectively. Reasons for the discrepancies are discussed. (auth)

29555 HYPERFINE SPLITTINGS OF HYDROGEN AND TRITIUM. [PART] II. F. M. Pipkin and R. H. Lamberts (Harvard Univ., Cambridge, Mass.). Phys. Rev., 127: 787-92(Aug. 1, 1962).

The spin-exchange optical polarization method was used to remeasure the zero-field hyperfine splittings of atomic hydrogen and atomic tritium. The transmission of circularly polarized rubidium resonance radiation through a flask containing rubidium, atomic hydrogen, or atomic tritium, and a buffer gas was monitored as a function of the frequency of an applied radio-frequency field. Measurements were made for hydrogen in helium, neon, molecular hydrogen, and argon buffer gases and for tritium in neon and argon buffer gases. The values of the hyperfine splittings obtained are $\Delta\nu(H) = 1{,}420{,}405{,}749.1 \pm 6.0$ cps; $\Delta\nu(T) = 1{,}516{,}701{,}476.8 \pm 6.0$ cps. The assigned limits of error represent the range of disagreement of the zero-pressure extrapolations in the different buffer gases. The fractional pressure shifts [pressure shift in cps/mm Hg divided by the hyperfine splitting in kMc/sec] for hydrogen in helium, neon, molecular hydrogen, and argon are 4.80 ± 0.09, 2.88 ± 0.05, -0.56 ± 0.10, and -4.77 ± 0.12, respectively. Those for tritium in neon and argon are 3.24 ± 0.09 and -5.05 ± 0.15, respectively. (auth)

29556 PARTIAL ATOMIC STOPPING POWER OF GASEOUS HYDROGEN FOR HYDROGEN BEAMS. [PART] I. S. K. Allison, J. Cuevas, and M. Garcia-Munoz (Univ. of Chicago). Phys. Rev., 127: 792-8(Aug. 1, 1962).

The stopping power of H_2 gas for the atomic component of a hydrogen beam in charge equilibrium has been measured by placing the stopping cell in an intense transverse magnetic field. This allows only those particles to reach the exit which have entered as neutrals and have not experienced any collision, as a result of which they became electrically charged. These neutrals are partially converted to protons in a subsequent gas stripper cell, and their energy measured in an electrostatic deflector. As H_2 gas is admitted to the stripping cell, there is a rapid decay in beam intensity, since at each charge-changing collision the particle is extracted from the beam by the magnetic field. By counting individual exit particles, however, a beam diminution factor of 10^{-7} is acceptable and a well-defined energy group is detected which has experienced a loss of approximately 1% of its energy, and for which the stopping power ϵ_0 of H_2 gas, for instance at 50 kev, is only 0.42 of the conventional ϵ, measured with the field off. The values of ϵ reported agree with those of Reynolds, Dunbar, Wenzel, and Whaling. The results for ϵ_0 and ϵ_0/ϵ are:

Kinetic energy (kev)	ϵ_0 in eV cm^2/atom	ϵ_0/ϵ
20	$(3.3 \pm 0.5) \times 10^{-15}$	0.64 ± 0.10
50	2.8×10^{-15}	0.42
100	1.8×10^{-15}	0.31
150	$(1.4 \pm 0.35) \times 10^{-15}$	0.30 ± 0.08

Above 50 kev the experimental ϵ_0 values agree well with those theoretically calculated by Dalgarno and Griffing for atomic hydrogen gas; at lower energies the experimental values are somewhat higher. (auth)

29557 PARTIAL IONIC STOPPING POWER AND THE ENERGY EXPANDED IN ELECTRON CAPTURE AND LOSS COLLISIONS OF PROTONS IN HYDROGEN GAS. [PART] II. M. N. Huberman (Univ. of Chicago). Phys. Rev., 127: 799-804(Aug. 1, 1962).

The experimental method of Allison, Cuevas, and Garcia-

Munoz for measuring atomic partial stopping powers (ϵ_a) has been extended to the determination of the stopping power ϵ_1 of hydrogen gas for the H^+ component of a hydrogen beam. The protons in a 1-mm dia. beam are held in an orbit which is an arc of a circle of 142-cm radius, and are guided to a 1-mm dia. exit after a path length of 55.8 cm in ~50 μ pressure of H_2 gas. The energy of the beam after leaving the stopping cell is measured by electrostatic deflection. No proton thus measured can have experienced a charge-changing collision in the stopping cell. In preliminary experiments protons were simulated by deuterons of twice the energy and ϵ_1 determined for protons of 55, 75, and 93 kev. Finally, an extended series of runs at 42.8 and 54.2 kev were made on ϵ_1, and a similar extended series on ϵ_0, with the apparatus arranged as in the work of Allison et al. These latter measurements for ϵ_1, ϵ, and ϵ_0 gave $(6.12 \pm 0.44; 6.36 \pm 0.16; 2.72 \pm 0.16) \times 10^{-15}$ ev cm^2/atom, and in the same units, for the higher voltage, $(6.04 \pm 0.39; 6.45 \pm 0.22; 2.91 \pm 0.29)$. Since the charge composition of the beam is known from other experiments, the charge-changing collisions may be shown to contribute 34% of the total stopping losses. The sum of the losses in kinetic energy in an electron capture and in its subsequent loss is 40 ± 6 ev at 42.8 kev and 54 ± 9 ev at 54.2 kev, neglecting charge-changing collisions involving H^-. (auth)

29558 TWO-QUANTUM TRANSITIONS IN THE MICROWAVE MAGNETIC RESONANCE SPECTRUM OF ATOMIC CHLORINE. George J. Wolga (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 127: 805-12 (Aug. 1, 1962).

Two-quantum microwave magnetic resonance transitions corresponding to $\Delta M_J = \pm 2$ have been observed for both stable isotopes of atomic chlorine, Cl^{35} and Cl^{37}. The experimentally observed and theoretically predicted positions of the two-quantum transitions agree within 13 parts per million, which was the precision of the experiment. The power dependence of the two-quantum transitions has been measured and checked with a "variation of constants" treatment of the microwave-induced probability amplitudes, and agreement has been found. Variations in intensity between corresponding $\Delta M_J = \pm 1$ and $\Delta M_J = \pm 2$ resonances were observed and analyzed on the basis of time-dependent perturbation theory and the Schwinger-Karplus expression for the line shape of a collision-broadened resonance with saturation. Satisfactory agreement with theory is found for these intensity variations. The linewidths for the $\Delta M_J = \pm 2$ lines are approximately half of that for the $\Delta M_J = \pm 1$ lines; this is in agreement with the results of time-dependent perturbation theory. (auth)

29559 SECOND-ORDER QUADRUPOLE EFFECT FOR THE NUCLEAR HEXADECAPOLE COUPLING IN IONS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 812-16(Aug. 1, 1962). (BNL-6038)

In connection with the possible existence of a nuclear electric hexadecapole moment, and the resulting large induced hexadecapole moment for medium and heavy ions due to antishielding effects, expressions have been obtained for the additional induced hexadecapole moment, H^Q_{ind}, due to the perturbation of the ion by the field of the nuclear quadrupole moment Q taken in second order. H^Q_{ind} is proportional to Q^2. Numerical results for some of the terms of H^Q_{ind} are presented for the Cu^+, Ag^+, and Hg^{2+} ions. (auth)

29560 MILLIMETER WAVE MOLECULAR BEAM SPECTROSCOPY: ALKALI BROMIDES AND IODIDES. James R. Rusk and Walter Gordy (Duke Univ., Durham, N. C.). Phys. Rev., 127: 817-30(Aug. 1, 1962).

The pure rotational spectra of the alkali bromides and the alkali iodides were investigated in the 1.5 to 5.0 mm range of the microwave region. The experiment was performed by passing a beam of molecules in the vapor state from an oven, capable of producing temperatures up to 1000°C, into an oversized section of wave guide so that the direction of incident microwave radiation was at right angles to the flow direction of the molecular beam. In this way linewidths less than 100 kc/sec at 100,000 Mc/sec were easily achieved. The line frequencies were measured with a precision better than one part in 10^6. The apparatus was developed as a series of modifications on an earlier experiment performed at this laboratory. Dunham's theory for diatomic molecules was applied in interpretation of the data. In most cases, the values for B_e, α_e, and γ_e were known although less accurately, but D_e and β_e were found for the first time. From the latter two, accurate determinations were made for the first time of ω_e and $\omega_e x_e$. From these values, information has been obtained about the potential functions, which suitably describe these diatomic alkali halides. In addition, centrifugal distortion constants, isotope mass ratios, moments of inertia, and internuclear distances have been accurately evaluated for each molecule. (auth)

29561 PERTURBATION ENERGY COEFFICIENTS AND IONIZATION POTENTIALS OF THE GROUND STATE OF THREE- TO TEN-ELECTRON ISOELECTRONIC ATOMIC SERIES. Charles W. Scherr, Jeremiah N. Silverman, and F. A. Matsen (Univ. of Texas, Austin). Phys. Rev., 127: 830-7(Aug. 1, 1962).

The well-known perturbation expansion, $E_{nr}^{(N)}(Z) = Z^2 \sum_{i=0}^{\infty} \epsilon_i^{(N)} Z^{-i}$, of the eigenvalues of the nonrelativistic Schrödinger equation for N electrons about a nucleus of charge Z has been widely used in the past for the extrapolation and interpolation of atomic energies. The presence of many small effects not explicitly taken into account by the perturbation expansion analysis reduce such calculations to a process of empirical curve fitting of limited range and reliability. These small effects include relativistic effects, the mass polarization, and the Lamb terms; to a good approximation, these effect can also be expanded in a descending power series, but with a leading term containing Z^3. On the basis of three plausible assumptions, theoretical approximations make it possible, in a semiempirical fashion, to remove a major portion of these small effects from the experimental data. In this way accurate values for $\epsilon_2^{(N)}$ and good estimates for $\epsilon_3^{(N)}$ have been obtained for $3 \leq N \leq 10$. These coefficients have been used to disclose inaccuracies and to fill gaps in the existing atomic energy data and to estimate electron affinities. (auth)

29562 PHONON-PHONON INTERACTIONS IN BOSE SYSTEMS. Mark Nelkin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Rev., 127: 979-86(Aug. 15, 1962).

The stability of phonons in Bose systems is considered. It is noted that the phonons in helium II are stable against decay into two or more phonons, in contrast to the low-density Bose gas where the lifetime for decay of one phonon into two is finite and has been calculated by several authors. The consequences of phonon stability for allowable mechanisms of phonon-phonon interaction are considered. It is concluded that virtual three-phonon processes may still occur although energy-conserving three-phonon processes cannot take place. The inclusion of such virtual processes makes it plausible that the interactions between excitations can be weak, even though the linewidths measured in neutron scattering are larger than the line shifts. The quantum

hydrodynamics of Landau and Khalatnikov including nonlinear terms is considered as a calculational model. In this theory the stability of the phonons is indeterminate and must be legislated. If the phonons are assumed unstable against decay, the phonon lifetime in the low-density and long-wavelength limit can be calculated, and is in agreement with the result for the atomic theory of the low-density Bose gas. This lends considerable plausibility to the quantitative validity of the Landau-Khalatnikov calculation of phonon-phonon scattering in helium II via an almost energy-conserving intermediate one-phonon state. The paper concludes by comparing the results of an idealized neutron scattering experiment as calculated from the Feynman-Cohen point of view, and from the point of view of the theory of the low-density Bose gas. (auth)

29563 CRITICAL VELOCITIES AND BOUNDARY INTERACTIONS IN THE ISOTHERMAL FLOW OF SUPERFLUID HELIUM. J. N. Kidder and W. M. Fairbank (Duke Univ., Durham, N. C.). Phys. Rev., 127: 987-94(Aug. 15, 1962).

The pressure gradient as a function of the superfluid velocity in a 1.1-mm-diam capillary has been measured at four temperatures between 1.26 and 1.57°K. In the flow tube the normal fluid was held at rest by ultrafine porosity filters, while the superfluid flowed isothermally. Superconducting microwave cavities were used as level indicators, making it possible to detect pressure gradients as small as 3×10^{-4} dyn/cm^3. A critical superfluid velocity, below which no pressure gradient could be detected, was observed directly. The critical velocity decreased linearly with temperature, being 1.25 mm/sec at 1.26°K, and 0.85 mm/sec at 1.57°K. For a superfluid velocity v_s greater than the critical velocity v_c, the variation of the pressure gradient with velocity could be described by $\alpha_2 v_s (v_s - v_c)$ or $\alpha_1 (v_s - v_c)^{1.7}$, where α_1 and α_2 are constants that vary with temperature. It is believed that this represents an interaction between vorticity in the superfluid and the wall of the flow tube. (auth)

29564 FLOW INSTABILITY IN LIQUID HELIUM II. R. Meservey (Yale Univ., New Haven). Phys. Rev., 127: 995-1003(Aug. 15, 1962).

The stability of steady, low-velocity laminar flow of the normal component of liquid helium II is shown to follow from the principle of minimum entropy production. It is pointed out that for two-fluid equations containing a nonlinear mutual friction term, this justification of stability is no longer valid when the energy dissipation by mutual friction is comparable to that by the viscosity of the normal-fluid component. An instability condition which is characterized by a dimensionless parameter ℨ (Gorter number) formed from the ratio of these two dissipative terms, is shown to predict the magnitude and temperature dependence of the critical velocities observed in heat conduction, boundary movement, and isothermal flow experiments in channels wider than 10^{-3} cm. Instabilities observed in heat conduction at higher velocities are shown to correlate with a Reynolds number of the usual form. The onset of the mutual friction force is discussed in the light of this phenomenological theory. (auth)

29565 QUANTUM EFFECTS IN Ge AND Si. [PART] I. J. J. Stickler, H. J. Zeiger, and G. S. Heller (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 127: 1077-84 (Aug. 15, 1962).

Experimental quantum effect spectra have been observed in germanium and silicon at liquid helium temperatures and a frequency of 136 kMc/sec. Detailed spectra are presented for the applied magnetic field in the [100], [111], and [110] directions. Anisotropy data of some of the more intense lines are also presented. Using the theory of Luttinger and Kohn with the assumption of thermal equilibrium, effective masses and line intensities were computed for an applied magnetic field in the [111] direction. By adjusting the parameters of the theory, good agreement was obtained between the theoretical and experimental spectra. The experimentally determined parameters are:

	γ_1	γ_2	γ_3	κ
Ge	13.2	4.10	5.62	3.29
Si	4.22	0.50	1.35	−0.39

These lead to parameters A = 13.2, |B| = 8.2, and |C| = 13.3 for germanium and A = 4.22, |B| = 1.0, and |C| = 4.34 for silicon. (auth)

29566 LOW-FREQUENCY MAGNETO-PLASMA RESONANCES IN SODIUM. F. E. Rose, M. T. Taylor, and R. Bowers (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 127: 1122-4(Aug. 15, 1962).

A detailed study of low-frequency magneto-plasma resonances ("helicons" or "whistlers") has been carried out in a series of rectangular parallelepipeds of sodium at 4°K. Many harmonics have been observed and quantitative correlation has been made between the observed resonances and the specimen geometry. The investigation yields the following value for the Hall coefficient in sodium: $|R| = 24.8 \times 10^{-11}$ m^3/C at 4°K corresponding to 0.94 electron per atom. (auth)

29567 NUCLEAR POLARIZATION IN POLYCRYSTALLINE HOLMIUM–INDIUM ALLOY. V. L. Sailor, R. I. Schermer, F. J. Shore, C. A. Reynolds, H. Marshak, and Hans Postma (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 1124-9(Aug. 15, 1962). (BNL-6058)

Holmium and indium nuclei have been polarized by nuclear hyperfine interaction in a polycrystalline ferromagnetic alloy, 92.2% holmium–7.8% indium. The nuclear polarization for each constituent was determined from the transmission of monochromatic, polarized neutron beams at neutron energies corresponding to resonances in the holmium and indium cross sections. A series of measurements at several temperatures from 0.071 to 4.225°K yield the following values for the hyperfine constant: for holmium, $A/k = 0.58 \pm 0.03$°K (corresponding to an effective field at the nucleus, $H_{eff} = +8.4 \times 10^6$ Oe); and for In, $A/k = -0.013 \pm 0.002$°K (corresponding to $H_{eff} = 1.3 \times 10^5$ Oe). The effect on the nuclear polarization of the magnetic anisotropy of the polycrystalline sample is discussed. (auth)

29568 THEORY OF SPIN PUMPING AND RELAXATION IN SYSTEMS WITH A LOW CONCENTRATION OF ELECTRON SPIN RESONANCE CENTERS. J. Korringa (Ohio State Univ., Columbus), D. O. Seevers, and H. C. Torrey. Phys. Rev., 127: 1143-50(Aug. 15, 1962).

A model is developed to describe nuclear relaxation and spin pumping caused by sparsely distributed electronic spins. It is assumed that the nuclei which are outside the interaction sphere of the paramagnetic centers are influenced indirectly via a fast diffusion process. Nuclei close to the electron spins are assumed to combine with these to form spin pairs of finite lifetime τ. Spin pumping and relaxation in these pairs is described phenomenologically. The coupling with a radio-frequency power source is described in terms of a spectral distribution function with Lorentzian shape. Simultaneous spin flips, made possible by the static part of the spin-spin interaction, are included. The equations for two-spin relaxation are generalized to

account for the fluid motion and electron spin relaxation as two independent sources of randomness. The results for relaxation and spin pumping are adapted to various special cases and compared with experiments. In particular, qualitative changes in the pumping process are shown to take place when the constant external magnetic field is changed from low to high values. (auth)

29569 CESIUM OSCILLATOR STRENGTHS. Philip M. Stone (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 1151-6(Aug. 15, 1962). (LADC-5245)

Cesium oscillator strengths are calculated using one-electron wave functions. These functions are numerical solutions of the Schrödinger equation with a central, symmetric potential and with the spin-orbit term. The potential is chosen so that the binding energies of the lowest ten levels agree with spectroscopic values to 3%; the next 30 levels agree to better than 1%. The validity of the wave functions is demonstrated by comparison of experimental and calculated values of: (i) ratios and magnitudes of principal series oscillator strengths, (ii) fine structure splitting of the doublets, and (iii) hyperfine splitting of the ground state. Oscillator strengths are presented for over one hundred transitions in the visible and infrared. Experimental support for many of these oscillator strengths is given by line intensity measurements. (auth)

29570 QUASI-CLASSICAL THEORY OF ELECTRON CORRELATIONS IN ATOMS. D. F. DuBois and M. G. Kivelson (RAND Corp., Santa Monica, Calif.). Phys. Rev., 127: 1182-92(Aug. 15, 1962). (RM-2899-AEC)

The quasi-classical limit of the many-particle perturbation theory is considered for electrons moving in the Coulomb potential of the nucleus. The problem is analyzed using the Green's function formulation of many-particle physics. When corrections involving the gradient of the self-consistent potential are neglected, the results agree to all orders in the interaction strength with the procedure of Lewis for including correlation corrections in the Thomas-Fermi model. The disagreement between the work of Lewis and the recent work of Baraff is shown to be due to the latter's neglect of anomalous contributions to the perturbation theory which arise, because the local Fermi momentum is a function of the interaction strength. The calculation of inhomogeneity corrections is also considered. (auth)

29571 NUCLEAR QUADRUPOLE RESONANCE OF Li IN FERROELECTRIC COMPOUNDS. Gerald Burns (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 127: 1193-6(Aug. 15, 1962).

Measurements have been made of the temperature dependence of the nuclear quadrupole coupling constant, eQq/h, of Li in a number of ferroelectric compounds. The compounds discussed are $LiNH_4C_4H_4O_8 \cdot H_2O$, $LiTlC_4H_4O_8 \cdot H_2O$, $LiTaO_3$, $LiNbO_3$ and $LiN_2H_5SO_4$. Powdered samples were used in all cases except the first where single crystals also measured and favorably compared with the powder results. (auth)

29572 INELASTIC SCATTERING OF GAMMA RAYS BY BOUND ELECTRONS. J. Varma and M. A. Eswaran (Atomic Energy Establishment, Trombay, India). Phys. Rev., 127: 1197-1203(Aug. 15, 1962).

With incident γ rays of energy 662 kev the energy spectrum of the photons inelastically scattered by the K-shell electrons of lead has been studied, employing NaI(Tl) scintillation spectrometers and coincidence techniques. The energy spectrum of the γ rays scattered at 124° to the incident direction is observed to be a continuum from zero energy to about 570 kev. At 60° also the spectrum shows the same trend. The observed photon energy spectrum is found to differ to a very great extent from that calculated on the basis of the various nonrelativistic theories. The cross section for the inelastic scattering of the 662-kev γ rays by a K-shell electron of lead, at 124°, for scattered photon energy greater than 160 kev is estimated to be (1.78 ± 0.16) times that by a free electron. (auth)

29573 IONIZATION OF ALKALI ATOMS BY ELECTRON BOMBARDMENT. Gilbert O. Brink (Univ. of California, Livermore). Phys. Rev., 127: 1204-6(Aug. 15, 1962). (UCRL-6806)

The relative ionization cross sections of lithium, sodium, and potassium have been measured over an electron energy range of threshold to 500 ev by a crossed-beam technique. The results for sodium and potassium are found to agree with those of previous workers. An attempt is made to correlate the structure observed in the potassium curve to the known energy levels of the atom. While the rubidium curve was not measured in this experiment, structure observed in it by other workers is discussed. (auth)

29574 DIATOMIC MOLECULAR ORBITALS FOR SMALL INTERNUCLEAR SEPARATIONS. David G. Fenton and Arnold Russek (Univ. of Connecticut, Storrs). Phys. Rev., 127: 1212-19(Aug. 15, 1962).

An approximate method is presented for the determination of the wave functions and the energy eigenvalues of the molecular orbitals of a homonuclear diatomic molecule at small internuclear separations. Solutions of the wave equation in spheroidal coordinates are derived in simple analytic form under the assumption of a screened two-center Coulomb field, the screening function being given by a certain analytic expression. This can be made to closely approximate the screening function which follows from the Thomas-Fermi statistical model for small internuclear separations. It is shown that with the screening function here set down, the solutions of the Schrödinger equation for an N-electron molecule are readily derived from the known exact solutions for the hydrogen molecular ion. Changes result only in the analogs of the radial parts of the latter solutions, and one obtains approximately self-consistent solutions for the general case at any small internuclear separation. To exemplify the method, computations have been carried out for the states of N_2 which are occupied in the ground state of this molecule, and for separations of 0.1, 0.2, 0.4, and 1.1 Bohr radii. The predicted energies are found to lie in the correct region of the energy correlation diagram. (auth)

29575 ELECTRONIC POLARIZABILITIES OF THE ALKALI ATOMS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 1220-3 (Aug. 15, 1962). (BNL-6003)

The electronic dipole polarizabilities α_d of the alkali atoms have been calculated by a method in which the inhomogeneous Schrödinger equation for the dipole perturbation u_1' (ns → p) of the valence electron wave function is solved directly. The theoretical results for α_d are in reasonably good agreement with the observed values from two recent experiments. (auth)

29576 COMBINATION COEFFICIENTS OF IONS AND NUCLEI. D. Keefe and P. J. Nolan (University Coll., Dublin). Proc. Roy. Irish Acad., A62: 43-53(May 1962).

Values of the ion–aerosol "nucleus" combination coefficient η_0 are calculated for various values of the nuclear radius, and are compared with experiment. It is shown that the use of the coefficient b in the equation $q = bnZ$ where q is the ion production rate, b is a nonequilibrium parameter replacing η_0, n is the ion concentration, and Z is the nuclear concentration, when equilibrium is absent, does not entail

serious error. Values of b are deduced by obtaining the ratio b/η_0 from the application of the Boltzmann law. The combination coefficients of charged and uncharged nuclei, for radii $> 3 \times 10^{-6}$ cm, are obtained. (auth)

29577 ANOMALOUS ELECTRON ABSORPTION EFFECTS IN METAL FOILS: THEORY AND COMPARISON WITH EXPERIMENT. H. Hashimoto, A. Howie, and M. J. Whelan (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A, 269: 80-103(Aug. 21, 1962).

The two-beam dynamical theory of electron diffraction in absorbing crystals is applied to explain features of bend and thickness extinction contours, and of images of stacking faults, observed in transmission electron micrographs of metal foils. Inelastic scattering processes affect the intensities of the elastically scattered waves and give rise to "anomalous" transmission effects. The formal theory takes account of these effects phenomenologically by the use of a complex lattice potential, but ignores the contribution of the inelastically scattered electrons to the image. In the theory absorption is described by certain parameters ξ_0' and ξ_g' with dimensions of length. These parameters are determined by Fourier coefficients of the imaginary part of the potential in the same manner as the extinction distance ξ_g is determined by the Fourier coefficient of the real part. A simple physical explanation of the "anomalous" absorption effect is developed in terms of the two crystal wave fields. The theory is phenomenological because the detailed mechanism of the absorption process is not understood. Nevertheless, comparison of the theory with observations enables the absorption parameters to be roughly estimated. (auth)

29578 TEMPERATURE DEPENDENCE OF DECAY TIME AND INTENSITY OF ALPHA PULSES IN PURE AND THALLIUM-ACTIVATED CESIUM IODIDE. Frank E. Senftle, Prudencio Martinez, and Victor P. Alekna (Geological Survey, Washington, D. C.). Rev. Sci. Instr., 33: 819-22(Aug. 1962).

The intensity and decay time of Po^{210} alpha particle scintillations produced in pure and thallium-activated cesium iodide were measured with a fast electronic system as a function of temperature down to 77°K. Three modes of decay due to alpha excitation were observed for CsI(Tl), and two for CsI. Other than the 7- and 0.55-μsec modes (at room temperature) reported in the literature for CsI(Tl), an additional temperature-independent mode of about 1.3 μsec was detected between 77 and 150°K. In CsI a fast temperature-dependent mode of decay ($\approx$ 100 nsec) was observed between 100 and 200°K in addition to the known principal mode. (auth)

29579 MAGNETIC SCREENING OF THE F^{19} NUCLEUS IN ALKALI FLUORIDE CRYSTALS. I-ch'iu Wang and M. Volodicheva (Leningrad State Univ.). Soviet Phys.-Solid State, 4: 467-9(Sept. 1962).

The chemical shifts of the nuclear magnetic resonance signals of fluorine in alkali halide crystals are calculated in the free-ion approximation. Agreement is achieved between the calculated results and experiment. An absolute evaluation is made of the magnetic screening effect for F^{19}. (auth)

29580 SPIN-LATTICE RELAXATION IN GADOLINIUM ETHYL SULFATE. S. A. Peskovatskii and A. N. Chernets (Inst. of Radiophysics and Electronics, Academy of Sciences, Kharkov). Soviet Phys.-Solid State, 4: 479-83 (Sept. 1962).

Spin-lattice relaxation phenomena at 9000 Mc were investigated in gadolinium ethyl sulfate at helium temperatures. It was found that, generally speaking, the relaxation curves were not exponential. Effective lattice oscillator heating had no influence on the relaxation rate. (auth)

29581 CONCENTRATION DEPENDENCE OF RELAXATION TIME IN GADOLINIUM ETHYL SULFATE AT HELIUM TEMPERATURES. S. A. Peskovatskii and A. N. Chernets (Inst. of Radiophysics and Electronics, Academy of Sciences, Kharkov). Soviet Phys.-Solid State, 4: 484-6 (Sept. 1962).

The concentration dependence of the spin-lattice relaxation time in gadolinium ethyl sulfate is determined at liquid helium temperatures and a frequency of 9000 Mc. The data obtained are compared with theoretical considerations concerning the spin-lattice relaxation mechanism at low temperatures. (auth)

29582 VIBRATION SPECTRUM OF GRAPHITE. L. P. Semenov. Soviet Phys.-Solid State, 4: 572-9(Sept. 1962).

The lattice vibration spectrum of graphite is studied. Expressions are obtained for the acoustic and optical frequencies for large wavelengths. (auth)

29583 CALCULATION AND CONSTRUCTION OF A STRONG FOCUSSED LINEAR ACCELERATOR. L. I. Bolotin, V. A. Suprunenko, E. I. Revutsky, and V. A. Bomko. Ukrain. Fiz. Zhur., 7: 132-7(1962). (In Ukranian)

The calculation and construction of a strong focused linear accelerator is presented. The theoretical treatment of the transit time factor is considered, and a comparison is made with the experimental values. (auth)

29584 ISOTOPIC EFFECT IN NAPHTHALENE CRYSTAL SPECTRA. E. F. Sheka. Ukrain. Fiz. Zhur., 7: 174-9(1962). (In Ukranian)

The electron absorption spectra of mixed crystals of naphthalene and deutero-substituted naphthalene were investigated at T = 20°K. It was established experimentally that the investigation of the spectra of isotopic compounds permits ascertaining the origin of sharply polarized bands of the inherent absorption of crystals, solving the question of their belonging to a definite Davidov multiplet, and makes it possible to determine the edges of the exciton zones, to establish their position in respect to the point k = 0, and points out the principles for determining the sign and value of the effective mass of the exciton. (auth)

29585 AVERAGE ENERGY EXPENDITURE FOR THE FORMATION OF AN ION PAIR IN VARIOUS GASES FOR X RADIATION FROM 100 TO 300 KV. Jochen Booz and Heinrich Georg Ebert (Universität Göttingen, Ger.). Z. angew. Phys., 14: 385-8(June 1962). (In German)

The average energy expenditure per ion pair in oxygen, methane, acetylene, ethylene, ethane, propylene, and propane was determined for x radiation from 100 to 300 kv relative to W_{air}. The ratio of the ionization currents i_{gas}/i_{air} was measured with a barrel chamber of 32-cm diameter. The ratio of the energies absorbed in the chamber was calculated from the x-ray spectra and the absorption coefficient. W_{air} = 38.8 ev was used as a reference value in calculating absolute values. (tr-auth)

29586 ISOTOPE EFFECT AND RARE GAS FREQUENCY IN STONE METEORITES AND UNDER THE EARTH. J. Zaehringer (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Naturforsch., 17a: 460-71 (June 1962). (In German)

The rare gas content of 19 various stone meteorites was investigated mainly for the abundance of the heavier components. Nine normal chondrites were selected, which indicated from the Ar^{36}/Ar^{38} ratio the presence of primordial rare gases. All of them contain primordial Kr and Xe as well as Xe^{129} excess. Their content is proportional to the

Ar^{36} content and increases in the sequence: normal chondrites, enstatite chondrites, and carbonaceous chondrites. The relative abundances of the rare gases in the Staroe Pesjanoe and Kapoeta meteorites follow very closely the Suess-Urey abundance curve. This may indicate that their composition is very similar to that of an undifferentiated solar nebula. The isotopic variations of meteoritic and terrestrial Ne and He can be explained by isotope-dependent diffusion in solids under the assumptions that all matter contained the rare gases in solar composition previous to degassing and that Kr and Ar have been lost to a much smaller extent. A similar process may be responsible for the Xe anomalies. Heating experiments confirm that the remaining gases are in thermally resistant components. The Xe^{129} problem is discussed under these aspects. (auth)

29587 INVESTIGATIONS ON STONE METEORITES WITH EXTREMELY HIGH RARE GAS CONCENTRATIONS. III. SITE OF THE LIGHT PRIMORDIAL RARE GASES IN THE CHONDRITE PANTAR. H. Koenig and F. Wlotzka (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 17a: 472-5(June 1962). (In German)

An investigation of the separated dark fraction of the chondrite Pantar was made. Rare gas analyses of separated minerals show that the main components of the meteorite, i.e., silicates, larger grains of nickel-iron, and troilite, contain only very small amounts of primordial helium and neon. The main amounts of these gases were found in fine-grained nickel-iron and troilite which are supposed to have been newly formed after the crystallization of the main minerals of the meteorite. Problems related to the variations of the He/Ne ratios which were found are discussed. (auth)

29588 THE SCHWARZSCHILD EXPONENT OF ILFORD Q PLATES FOR IONS OF MEDIUM MASS. J. Franzen and E. Hebeda (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 17a: 476-8(June 1962). (In German)

The Schwarzschild exponent of Ilford Q1, Q2, and Q3 plates was measured in the region of primary darkening with consideration of the sensitivity fluctuations along the plate for the rare gas monovalent ions Ne^{22}, Ar^{36}, Kr^{82}, and Kr^{86} at an energy of 30 kev. The current density and exposure time were varied by 3.5 powers of ten. For exposure time of 0.07 to 240 sec the Schwarzschild exponent was determined to be $P = 1.014 \pm 0.007$ for Q1 plates, $P = 1.011 \pm 0.008$ for Q2 plates, and $P = 1.004 \pm 0.007$ for Q3 plates. (tr-auth)

29589 INVESTIGATIONS ON THE ANGULAR DEPENDENCE OF THE 14.7-ev ENERGY LOSS OF ELECTRONS IN ALUMINUM. H. Boersch, H. Miessner, and W. Raith (Technische Universität, Berlin). Z. Physik, 168: 404-10 (1962). (In German)

In a device described in a previous paper, the angular dependence of the 14.7 ev energy loss of aluminum was measured. The dispersion coefficient and the angular dependence of the intensity of this energy loss are in good agreement with the plasma theory. The cut-off angle was found somewhat smaller than expected. (auth)

29590 MAGNETOSTRICTION OF Tb AND Ho. S. A. Nikitin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 31-4(July 1962). (In Russian)

Magnetostriction of Tb and Ho is measured in magnetic fields up to 15000 Oe. The magnetostriction of Tb is very large ($\lambda_{\parallel} = 750 \times 10^{-6}$, $\lambda_{\perp} = -460 \times 10^{-6}$ for $T = 85°K$) in the low-temperature region in which it is in the ferromagnetic state ($T < \Theta_1 = 219°K$). Near the antiferromagnetism–paramagnetism transition temperature ($\Theta_2 = 230°K$) of Tb, magnetostriction of the paraprocess is observed and is anisotropic. At temperatures at which Ho is in the antiferromagnetic state the magnetostriction is very small in magnitude ($\lambda_{\parallel} \approx 7 \times 10^{-6}$), anisotropic ($\lambda_{\parallel} > 0$, $\lambda_{\perp} < 0$), and monotonically decreases upon approaching $\Theta_2 = 133°K$. (auth)

29591 INELASTIC COLLISIONS OF LIGHT ATOMS IN THE ADIABATIC APPROXIMATION. B. M. Smirnov (Moscow Inst. of Engineering Physics). Zhur. Eksptl'. i Teoret. Fiz., 43: 112-16(July 1962). (In Russian)

The integral corresponding to the transition probability amplitude is computed by the saddle point method. For determination of the transition probability it is sufficient to find the matrix elements of the atom produced by combining the nuclei of the colliding atoms. With decreasing relative velocity (v) of the nuclei, the inelastic scattering cross section first decreases as v^4 and then exponentially. The charge exchange cross section for protons on helium is computed. (auth)

29592 REMARK ON THE RANGE-ENERGY RELATIONSHIP. To Ying Seb (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 121-5 (July 1962). (In Russian)

The range of heavy charged particles in matter can be expressed with sufficient accuracy by a universal function. Using this function the range-energy relation can be written in the form $E = aR^m$ where m is independent of the composition of the substance. (auth)

29593 VISCOUS BOUNDARY LAYER IN MAGNETOHYDRODYNAMICS FOR FINITE $\omega\tau$. A. I. Gubanov and O. E. Pushkarev. Zhur. Tekh. Fiz., 32: 657-62(June 1962). (In Russian)

Boundary-layer equations for a conducting fluid in a homogeneous magnetic field are derived, considering conductance a function of field intensity. The case of a thin plate was resolved by using the Carman-Paulhausen method. A transverse velocity component and somewhat thinned boundary layer were observed in contrast to ordinary magnetohydrodynamics. (tr-auth)

29594 MEASURING OF THE CROSS-SECTION OF DOUBLE RECHARGING OF ONECHARGED POSITIVE IONS FOR LOW ENERGY. V. F. Koslov and A. M. Rozhkov. (Inst. of Physics and Tech., Academy of Sciences, Khar'kov). Zhur. Tekh. Fiz., 32: 719-24(June 1962). (In Russian)

A new method based on separation of positive primary ions from negative secondaries by means of a bremsstrahlung field, is suggested for measuring effective double-charge exchange cross sections for singly charged positive ions with 0.1 to 5 kev energies. The results were correlated with published data. (R.V.J.)

29595 ENERGY ELECTRON DISTRIBUTION IN THE POSITIVE DISCHARGE. Yu. M. Kagan and R. I. Lagushchenko (Leningrad State Univ.). Zhur. Tekh. Fiz., 32: 735-7(June 1962). (In Russian)

Possible deviations from Maxwell distribution are analyzed at various electron velocities. (tr-auth)

29596 SPARK DISCHARGE OF AN INTENSIVE LIGHT FLASH OF 10^{-7} to 10^{-8} SEC. II. INVESTIGATION OF THE OPTIMUM RELATIONSHIP BETWEEN ENERGY SPARK DISCHARGE IN THE AIR AND LIGHT FLASH DURATION. S. I. Andreev and M. P. Vanyukov. Zhur. Tekh. Fiz., 32: 738-45(June 1962). (In Russian)

The influence of discharge parameters (induction and discharge contour, condenser intensity, and discharge time) on the velocity and energy in the spark channel was studied

in order to determine the optimum relation between discharge energy and flash intensity. (tr-auth)

29597 INFLUENCE OF THE ELECTRODE BARRIERS ON THE ELECTROCONDUCTIVITY OF CESIUM PLASMA. A. M. Martsinovskii, G. E. Pikus, B. E. Sonin, and V. G. Yur'ev (Inst. of Semiconductors, Academy of Sciences, Leningrad). Zhur. Tekh. Fiz., 32: 770-2(June 1962). (In Russian)

A method for measuring cross sections, using Cs plasma conductance between two identically heated electrodes, was analyzed. The plasma resistance was measured as a function of inter-electrode distance R(d) in order to determine the role of the pre-electrode barrier. In all instances R increases linearly with inter-electrode distance. An increased resistance, R_0, induced by pre-electrode layers was observed at elevated temperatures. Further theoretical studies were made of pre-electrode effects on the ratio of electrode yield and chemical potential. (R.V.J.)

29598 NEKOTORYE VOPROSY VZAIMODEISTVIYA ZARYAZHENNYKH CHASTITS S ELECTRICHESKIM POLEM. (Certain Problems in Charged Particle Interactions with Electric Field). G. M. Gershtein. Publishing House of Saratov Univ., 1960. 166p.

The basic processes of charged particle interaction with a-c fields are analyzed. Special attention is given to particle bunching in devices with dynamic control, particle current induction, and relations between spatial field distribution and inducted current variations. An analysis is made of the Shockley-Ramo theorem establishing the relation. Interactions between charged particles, spatial wave charge, and non-resonance magneton oscillations are also analyzed. (R.V.J.)

Astrophysics and Cosmology

29599 (AFOSR-3024) ABUNDANCES OF ELEMENTS IN STARS AND NEBULAE. (THE ABUNDANCE OF CERTAIN ELEMENTS IN THE SOLAR ATMOSPHERE). Technical Note No. 2. L. H. Aller (Michigan. Univ., Ann Arbor. Coll. of Literature, Science, and the Arts). June 1962. Contract AF49(638)-807. 34p. (ORA-03719-2-T)

The solar abundances of 21 elements (Na, Sc, Cu, Zn, Ga, Ge, Sr, Y, Zr, Nb, Mo, Ru, Rh, Pd, Ag, Cd, In, Sn, Sb, Ba, and Yb) are revised with the aid of gf-values obtained. Some implications of the new measurements are discussed and it is emphasized that a comprehensive reconsideration of solar abundances should be undertaken, in which ions as well as neutral atoms and a new model solar atmosphere are used. (auth)

29600 (TID-16442) THREE COLOR PHOTOMETRY OF THE SPECTRUM VARIABLE STAR 56 ARIETIS (thesis). Norman Harold Schroeder (Vanderbilt Univ., Nashville). June 1962. 42p.

A photometric study of the spectrum variable star 56 Arietis was made at the cassegrainian focus of the 24-in. telescope of the Dyer observatory. All observations were carried out with a three-color photometer. A total of 82 observations in each of the three colors (visual, blue, and ultraviolet) were obtained on 56 Arietis during 10 nights. Each observation was made between two observations of a comparison star. This study confirmed many of the conclusions noted by Provin: the small amplitudes of light variation, the existence of the secondary minimum, the period of the light variation, and the mean values of the color indices. In addition, the light-curve was proved stable over a nine year interval and an improved period was determined. The three-color diagram indicated that 56 Arietis remains in the B7 region throughout its light variation and that it describes a clockwise loop in its color variation. (M.C.G.)

29601 THE EVOLUTION OF MASSIVE STARS. III. HYDROGEN EXHAUSTION THROUGH THE ONSET OF CARBON-BURNING. Chushiro Hayashi (Kyoto Univ.), and Robert C. Cameron. Astrophys. J., 136: 166-92(July 1962).

The evolution of a population I star of 15.6 solar masses and having an age-zero composition of X = 0.90, Y = 0.08, and Z = 0.02, is computed for advanced evolutionary phases: hydrogen exhaustion in the convective core; the subsequent gravitational contraction of the core; helium-burning; the onset of carbon-burning; and the onset of neon-burning in the absence of a preceding carbon-burning phase. It is assumed that there is no mass loss from the stellar surface, that no mixing occurs except in the convective core, and that the opacity is due entirely to electron scattering. Radiation pressure is taken fully into account. The hydrogen-exhaustion phase is taken to begin when $X_{core} = 0.02$. The effective temperature increases slightly for 1.4×10^6 years, while X_{core} decreases to 0.0001. Hydrogen-burning in the core gradually ceases to be effective. When the energy sources arising gravitational contraction and hydrogen-burning in a thin shell at the core boundary become important (simultaneously), the envelope begins to expand rapidly. An excursion in the evolutionary track takes place in 7×10^4 years, at which point the star begins to burn helium as an A3 supergiant. The hydrogen-burning shell source continues to be important. The star then evolves to the left in the color–mass diagram for 2×10^5 years until $Y_{core} = 0.35$ and the spectral class is B3. The direction of the track again reverses. In an additional 3×10^5 years the star again becomes an A3 supergiant, then rapidly crosses the Hertzsprung gap, reaching the M-type supergiant region in another 2×10^4 years, with the helium in the core nearly exhausted. The mass of the convective core in the helium-burning phase increases monotonically, at least until Y_{core} becomes as small as 0.016. This circumstance is favorable, in that no new inhomogeneous radiative zone, whose composition is dependent on the evolutionary history, is created. The total time spent in helium-burning, 1.2×10^6 years, is about one-fourteenth of the period spent in hydrogen-burning. Helium-burning accounts for the early-type supergiant branch of luminous galactic clusters such as h and χ Persei. Furthermore, the suggestion of a gap, which appears in the color–mass diagram of h and χ Persei between the upper main-sequence stars and the early-supergiant branch is to be expected according to the results. The clusters NGC 330 and NGC 458 in the Small Magellanic Cloud show the gap more clearly. For the sake of comparison, some computations are performed for a star of 10.1 solar masses and a more "normal" age-zero population I composition, X = 0.61, Y = 0.37, and Z = 0.02. Preliminary results are obtained for the onsets of the subsequent carbon- and neon-burning phases. The very large stellar radii obtained are reduced considerably when the surface convection zone is taken into account, while the quantities which characterize the inner structure are expected to remain essentially unchanged. Carbon-burning and more advanced evolutionary phases, which have a total lifetime of the order of 10^6 years, probably account for the M-type super-giant branch of h and χ Persei and similar clusters. (auth)

29602 GAS IMPERFECTIONS AND PHYSICAL CONDITIONS IN GASEOUS SPHERES OF LUNAR MASS. Janet Bainbridge (Univ. of California, San Diego, La Jolla). Astrophys. J., 136: 202-10(July 1962).

The central physical conditions of lunar-sized masses of imperfect gas are computed. It is shown that the physical conditions at the interface of a solid central mass and surrounding gas and those at the center of a gas mass are the same, to a first approximation, if the solid mass is of the order of 1/300 the total mass of the sphere. The relevance of these conditions to the condensation of solids and their subsequent remelting is discussed. (auth)

29603 IONIZATION AND EXCITATION EQUILIBRIUM OF Ca II IN THE SOLAR ATMOSPHERE. R. Grant Athay (High Altitude Observatory, Boulder, Colo.) and J. B. Zirker. Astrophys. J., 136: 242-9(July 1962).

Ionization and excitation configurations for Ca II are computed for conditions appropriate to the solar chromosphere. The populations of energy levels are found to depart sharply from the local-thermodynamic-equilibrium values at corresponding values of T_e. The dominant ionization process of Ca II is shown to be via collisions from the 3D level and to exhibit fundamental differences from H, He, and Mg I, as well as some similarities. For electron densities and temperatures such as are expected in most of the solar chromosphere and corona, the ratio Ca II/Ca III is shown to be essentially independent of electron density, rather than directly proportional as predicted by the Saha equation. Computations of opacities and occupation numbers indicate that the Ca II H and K lines in the Fraunhofer spectrum are formed near the top of the hydrogen temperature plateau, where $T_e \approx 15{,}000°$, and that the Ca II emission from spicules arises from regions where $T_e \approx 15{,}000°$ rather than the much higher temperature derived from profiles of hydrogen and helium lines. (auth)

29604 SPECTRAL OBSERVATIONS OF SOLAR CHROMOSPHERIC SPICULES. J. B. Zirker (Sacramento Peak Observatory, Calif.). Astrophys. J., 136: 250-7 (July 1962).

Chromospheric spicules are observed with high spectral and moderate spatial resolution in Hα, Hβ, H, and K. Individual spicules seem to have much larger line widths than do quiescent prominences. All strong lines (including H and K) except D_3 change from self-reversed or flat-topped to Gaussian profiles with increasing height. D_3 has a Gaussian profile whose half-width increases with height. (auth)

29605 MEASUREMENTS OF THE POLARIZATION AND ANGULAR EXTENT OF THE DECIMETER RADIATION FROM JUPITER. D. Morris and G. L. Berge (Owens Valley Radio Observatory, Calif.). Astrophys. J., 136: 276-82(July 1962).

Interferometric measurements of the non-thermal radiation from Jupiter are made at 960 and 1390 Mc. These measurements yield the flux density and polarization of the source and its over-all dimensions in the polar and equatorial directions. The measured values can be accounted for by synchrotron radiation from electrons trapped in a Jovian Van Allen belt. Variations in the intensity and plane of polarization of the 1390-Mc radiation suggest that Jupiter's magnetic axis is inclined at 9° to its rotational axis. The magnetic poles are at System III longitudes of 200 and 20°. It is noteworthy that the pole at 200° coincides with the principal decameter radio source. (auth)

29606 A POSSIBLE EXPLANATION FOR JOVIAN DECAMETER BURSTS. Stephen E. Strom and Karen M. Strom (Harvard Univ., Cambridge, Mass. and Smithsonian Astrophysical Observatory, Cambridge, Mass.). Astrophys. J., 136: 307-9(July 1962).

Bursts of 5- to 30-Mc noise from Jupiter are explained on the basis of a model in which ionized portions of the Jovian atmosphere act as a lens for the photons from radio stars. By calculations based on an electron-density model for the Jovian atmosphere, and assuming a magnetic dipole field strength of 2 Oe, a power gain on the order of 10^3 is estimated. The periodicity of the bursts with rotation is explained by the hypothesis that the magnetic dipole and rotation axes of Jupiter are tilted with respect to one another. It is assumed that the focusing mechanism is operative only when Jupiter is occulting a radio star. It is thus expected that the burst duration should increase as the apparent background velocity of Jupiter decreases; this effect is, in fact, observed experimentally. (T.F.H.)

29607 THE TRANSITION FROM HYDROGEN BURNING TO HELIUM BURNING IN A STAR OF FIVE SOLAR MASSES. Emil Joseph Polak (Princeton Univ., N. J.). Dissertation Abstr., 23: 25(July 1962).

The evolution of an early main sequence star of five solar masses with an assumed composition is considered. Twenty-one evolutionary models are developed taking the star from the initial main sequence model to, and including, a hydrogen exhausted core, and then its progress to a point on the giant branch where the core contraction causes the central temperature to race upwards toward conditions required for helium burning. It is found that the mass fraction within the convective core decreases and ultimately vanishes when the hydrogen content of the star's center is depleted. With the diminishing of the convective core there is created an inhomogeneous zone between the existing cores and the corresponding radiative envelopes. Hydrogen burning on the carbon cycle is the energy source inside the core during the early phases of the star's evolution and following the exhaustion of hydrogen at the stellar center, the development and progress of the newly created distinct shell energy source by hydrogen burning is studied. The predicted S-shaped evolutionary track in the H R diagram is confirmed. The separate contributions of nuclear burning and contraction to $L/L_\odot$ of the model star are determined. (auth)

29608 ON THE INTERNAL CONSTITUTION OF THE INNER PLANETS. Gordon J. F. MacDonald (Univ. of California, Los Angeles). J. Geophys. Research, 67: 2945-74 (July 1962).

The internal structures of the moon, Mars, Venus, and Mercury are examined in the light of what is known about the constitution of the earth. A review of the seismic determination of the elastic constitution of the earth's mantle, using results on the stability of silicates at high pressures, leads to the following interpretation: the rapid increase of velocity beginning at 200 km depends on the olivine-spinel transition and the breakdown of silicates to oxides. Preliminary calculations of the stability field of periclase (MgO) and stishovite (high-density SiO_2) relative to olivine ($MgSiO_4$) indicate that the oxides are stable at pressures greater than 1.0×10^5 to 1.5×10^5 bars. The oxide transition produces a change in volume of about 20 per cent. The gravitational figure of the earth, as obtained from satellite orbits, is used to estimate the possible deviations from hydrostatic equilibrium on other planets. The near coincidence of the present rate of heat production of a chondritic earth and the present surface heat flow is discussed as a limiting condition of the internal thermal structure of the earth. Observations of the orbital and rotational motion of the moon give its gravitational figure. Calculations of its thermal structure show that a model moon with uniform radioactivity and chondritic composition is inconsistent with the calculated gravitational figure. The inferred strength of the moon requires either that the radioactivity be substantially less than that of chondrites or that the heat sources be concentrated in the outer layers. The problem

of differentiation without melting is noted. The average lunar material has a radioactivity perhaps one-half, or less, that of chondritic materials. The astronomical data on the mean density and gravitational figure of Mars are examined. If the mean radius of Mars is taken to be 3310 km, the planet must have a surface density of about 3.8 to 3.9 and must be nearly homogeneous. If Mars were homogeneous and had a radioactivity equal to that of chondrites, the interior would be molten and large-scale gravitational differentiation would be expected. Since this differentiation is not apparent in the gravitational data, it is concluded that the radioactive composition of Mars differs from that of chondrites. The internal structures of Mercury and Venus are examined in terms of their inferred rotational history. In conclusion, the inner planets differ both in the abundances of the heavy elements and in the abundances of potassium, uranium, and thorium. Chondrites may provide a satisfactory chemical model for the earth but not for the other inner planets; Venus is a possible exception, only on the grounds of ignorance of its internal constitution. (auth)

29609 ORIGIN OF ELEMENTS. C. de Jager (Sterrewacht "Sonnenborgh", Utrecht). Ned. Tijdschr. Natuurk., 26: 157-74(June 1960). (In Dutch)

A brief survey is made of the principal theories on the origin of elements. The topics considered are place of origin, evolution of stars, thermonuclear reactions, the element abundancy curve, slow neutron reactions, fast neutron reactions, and the Fe peak. (J.S.R.)

Cosmic Radiation

29610 (D1-82-0175) WHISTLER ATTENUATION BY ELECTRONS WITH AN $E^{-2.5}$ DISTRIBUTION. H. B. Liemohn (Boeing Scientific Research Labs., Seattle) and F. L. Scarf (Washington. Univ., Seattle). June 1962. 15p.

The thermal (Landau) attenuation of natural whistler radiation was examined assuming that the electron component has a velocity distribution of the (Cauchy) form $\sim(v^2 + a^2)^{-3}$ which corresponds to an energy dependence of $E^{-2.5}$ when $|v| \gg a$. It was found that a temperature of $\sim 10^5$ °K at $R \simeq 4R$ geocentric is required in order to explain the observed cutoff at $\omega \simeq 0.6\ \omega_c(0°)$ where $\omega_c(0°)$ is the minimum cyclotron frequency along the path. The results were not appreciably different from those obtained previously using a Maxwell distribution. However, a simple algebraic expression was obtained for the electron temperature which makes the analysis of a large number of whistler traces feasible. The exact shape of the distribution and the concept of temperature are only relevant in the sense that they give the fraction of electrons which participate in the damping interaction at the Doppler shifted phase velocity $v_\phi(\omega) = (\omega - \omega_c)/R_e\, k(\omega)$. For a total density of 200 electrons/cm³ at $R \simeq 4R_e$, the thermal attenuation mechanism predicts an electron flux of $\sim 4 \times 10^5$ electrons/cm² sec ev for energies near 250 ev. (auth)

29611 (HASL-130) ENERGY ABSORPTION SPECTRUM IN AIR OF COSMIC RAY MU MESONS AT SEA LEVEL. Howard Grotch (New York Operations Office. Health and Safety Lab., AEC). Sept. 1962. 19p.

The energy absorption spectrum of cosmic mu mesons at sea level was inferred from the omnidirectional momentum spectrum, the latter being obtained from the directional intensities of muons in various energy intervals at zenith angles of 0, 30, 60, and 68 degrees. These directional intensities were found from the differential momentum spectra given by Wada. The total omnidirectional intensity was found to be 1.70×10^{-2} muons/cm²/sec, a value in excellent agreement with that of other investigators. From the energy absorption spectrum, a sea level muon dose rate of 2.23 microrads per hour was determined. This is consistent with measurements of the total cosmic dose rate. (auth)

29612 (NARF-62-11T) A SPACE TRAJECTORY RADIATION EXPOSURE PROCEDURE FOR CISLUNAR MISSIONS. W. Cranford, R. F. Falkenbury, and R. A. Miller (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). July 31, 1962. Contract AF33(657)-7201. 101p. (FZK-9-178)

The Space Trajectory Radiation Exposure Procedure (STREP) is designed for use in computing the time-integrated spectra for any specified trajectory in cislunar space for any combination of the several components of space radiations. These components include Van Allen protons and electrons; solar-flare protons, electrons, heavy particles, and gamma radiation; cosmic protons and heavy particles; albedo neutrons, and aurora borealis gamma radiation. The program can also be used to calculate the accumulated dose behind a thin vehicle skin at any time after the start of the mission. The technique of interpolation for intermediate points along the prescribed space trajectory is described in detail. The method of representation of the space radiation data as input for the calculation of the dose and time-integrated spectra is discussed. (auth)

29613 (TID-6086) TRAPPED PARTICLES AND RING CURRENT AROUND THE EARTH. S. Olbert and B. Rossi (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [1960]. Contract [AT(30-1)-2098]. 4p.

The magnetic effects of trapped radiation are explained by known equations of magnetic force and current density. Factors affecting the calculations, such as drift, diamagnetic behavior of the trapped particles, gravity, and inertial forces, are discussed in relation to the equations. The very existence of a magnetically trapped plasma implies the presence of a boundary through which there is a sharp pressure drop, balanced by a magnetic force $\vec{j} \times \vec{B}$. Thus, magnetic storms are not related to the formation of a new ring current, but rather to changes in the location and intensity of the current which normally exists at the boundary of the trapping region. (N.W.R.)

29614 A CRITICISM OF METAGALACTIC HYPOTHESES FOR THE ORIGIN OF COSMIC RAYS. V. A. Razin (N. I. Lobachevskii Gorkii State Univ., USSR). Astron. Zhur., 6: 20-3(July-Aug. 1962). (In English)

Every hypothesis that cosmic rays originate beyond the galaxy implies that their energy density $W_{c.r.}$ is the same in galactic and intergalactic space. The average value of $W_{c.r.}$ in the universe should then be about 10^{-12} erg/cm³. Under cosmic conditions, the energy density of the magnetic field is presumably of the same order as that of the cosmic rays. The magnetic field strength in intergalactic space should therefore be about $(8\pi W_{c.r.})^{\frac{1}{2}} \sim 5 \times 10^{-6}$ gauss. But if the magnetic field were as strong as this, the radio emission from the metagalactic region would be several orders greater than is observed. This contradiction, and several other difficulties, compel the rejection of hypotheses for the metagalactic origin of cosmic rays. (auth)

29615 THE HYPOTHESIS CONCERNING THE CONE OF AVOIDANCE IN THE PROBLEM OF THE ORIGIN OF CORPUSCULAR STREAMS. É. R. Mustel' (Astronomical Council, Academy of Sciences, USSR). Astron. Zhur., 6: 28-32(July-Aug. 1962). (In English)

Two hypotheses are compared, that of the cone of avoid-

ance (AC hypothesis) and that of the active regions (AR hypothesis). For this purpose, the "central" plages (C_0 plages) used in the superposition-of-epochs method, that is, the central plages corresponding to the moment $\Delta t = 0$, are divided into groups. Each group contains only those C_0 plages for which the nearest leading plages, i.e., the adjacent plages with greater longitudes, are separated from the C_0 plages by a distance ΔL_0. The AR hypothesis is confirmed by the results, and the AC hypothesis is contradicted. The problem of the amplitude of the geomagnetic-field variations is considered. (auth)

29616 TIME VARIATIONS OF INTENSITY IN THE EARTH'S INNER RADIATION ZONE—OCTOBER 1959 THROUGH DECEMBER 1960. Guido Pizzella (Iowa State Univ., Iowa City). Dissertation Abstr., 23: 268(July 1962).

Time variations of almost a factor of three were observed in the lower portion of the inner Van Allen belt with the Anton 302 Geiger tube in Explorer VII (satellite 1959 Iota) during the period October 13, 1959 through December 31, 1960. The time variation appears to occur in discrete steps which are temporally correlated with major solar proton events and/or major geomagnetic storms. In one instance, a significant change in inner zone intensities occurred within a period of less than two weeks. It is concluded that a strong impulsive source of the trapped particles throughout the inner zone exists and is of more quantitative importance than the neutron albedo decay products of the galactic cosmic radiation. (auth)

29617 OBSERVATION OF THE VAN ALLEN RADIATION REGIONS DURING AUGUST AND SEPTEMBER, 1959. IV. THE OUTER-ZONE ELECTRONS. R. L. Arnoldy, R. A. Hoffman, and J. R. Winckler (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 2595-2612(July 1962).

A study is reported of the data from radiation detectors abroad the Explorer VI earth satellite as the spacecraft passed through the outer zone during a period when the count rate time variations and the geomagnetic activity were low. The radiation detectors aboard the satellite were an ionization chamber, a Geiger counter, a proportional counter telescope, and a scintillator. Calibrations were made to determine the response of these detectors to monoenergetic electrons when inside a spare payload. In using these calibrations and fitting assumed power-law spectra of electrons to the data, it is seen that the spectrum is flat and must extend to several Mev at the small ranges, with the ion chamber and Geiger counter responses there caused primarily by direct electron detection. The intensity of the energetic electrons is shown to decrease with increasing range as the spectra steepen and the radiation softens, resulting in an increasing contribution of bremsstrahlung to the rates of the chamber and Geiger counter. Any attempt to utilize the bremsstrahlung response of the Explorer IV detectors to determine fluxes is useless if an appreciable portion of their counting rate is produced by direct energetic particles. The spectral shape of the outer zone, as suggested by this analysis, allows an interpretation to be made of the minimum observed in the Geiger counter rate at an equatorial geocentric range of 19,000 km as having spectral-detector origin rather than as representing the removal of radiation by an anomaly in the earth's magnetic field. This analysis is only capable of fitting trial spectra to the data; the procedure does not eliminate the possibility of more complex spectra existing in the outer zone, which would lead to different conclusions about the nature of the trapped radiation. (auth)

29618 THE FLUX OF HEAVY NUCLEI IN THE JULY 10, 1959 FLARE. S. Biswas (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 2613-15(July 1962).

During 59 to 70 hours after the July 10, 1959, flare, the differential energy spectra of M nuclei ($6 \leq Z \leq 9$) and H nuclei ($Z \geq 10$) were measured in the energy intervals 150 to 500 and 200 to 500 Mev/nucleon, respectively. Also the integral flux of H nuclei of energy > 500 Mev/nucleon was measured. It was concluded that during this period the flux of solar M nuclei was $\lesssim 0.9 \pm 0.3$ per cent of the solar α-particle flux in the energy interval 150 to 200 Mev/nucleon; and the flux of solar H nuclei of energy 200 to 300 Mev/nucleon was zero or undetectable. (auth)

29619 THE MEASUREMENT OF THE CUTOFF RIGIDITY AT MINNEAPOLIS USING SOLAR PROTONS AND α PARTICLES FROM JULY 10, 1959, FLARE. Phyllis S. Freier (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 2617-26(July 1962).

The integral energy spectra of solar protons and α particles were obtained during six balloon flights in the three days following the solar flare of 0210 UT, July 10, 1959. Two of the flights occurred at Fort Churchill, Canada, where the cutoff rigidity imposed by the earth's magnetic field was very much less than the cutoff imposed by the air above the balloon. Therefore, in these two flights the measured energy spectra were those existing in the solar beam. In four flights at Minneapolis, the measured energy spectra represented the spectra in the solar beam modified by the earth's magnetic field. From an analysis of both counter results and emulsion results, the time variation of the cutoff rigidity at Minneapolis is obtained. The quite time cutoff at Minneapolis was 1.2 bv but showed a sharp decrease even before the sudden commencement of the magnetic storm that followed the flare. During the magnetic storm the cutoff rigidity was reduced to 0.7 bv or less. In the rigidity interval 0.8 to 1.0 bv the abundance of protons to α particles was 1.4 from 30 to 38 hours after the flare. The α-particle flux decreased faster than the proton flux, and 59 to 70 hours after the flare the proton-to-α-particle ratio was 5. (auth)

29620 GAMMA RAYS FROM THE SOLAR-COSMIC-RAY-PRODUCED NUCLEAR REACTIONS IN THE EARTH'S ATMOSPHERE AND LOWER LIMIT ON THE ENERGY OF SOLAR PROTONS OBSERVED AT MINNEAPOLIS. Praful D. Bhavsar (Univ. of Minnesota, Minneapolis). J. Geophys. Research, 67: 2627-37(July 1962).

Gamma rays from solar-cosmic-ray-produced nuclear reactions in the earth's atmosphere are observed by balloon-borne NaI(Tl) scintillation detectors. An attempt is made to understand the processes that lead to γ-ray production, and the total cross section for γ-ray production in air by protons of 30 to 300 Mev is calculated to be $\sigma_\gamma \approx 940 \times 10^{-27}$ cm^2. Assuming that the information about the solar proton spectrum obtained from the directly measured protons above 110 Mev can be applied to protons below 110 Mev, the minimum energy with which the protons arrive over Minneapolis during the storm is estimated. Such estimations during the May 12, 1959, event show that solar protons of energy as low as 30 to 40 Mev are allowed at the middle-latitude station of Minneapolis. (auth)

29621 FORBUSH DECREASES PRODUCED BY DIFFUSIVE DECELERATION MECHANISM IN INTERPLANETARY SPACE. H. Laster, A. M. Lenchek, and S. F. Singer (Univ. of Maryland, College Park). J. Geophys. Research, 67: 2639-43(July 1962).

Transient decreases in the intensity of galactic cosmic radiation are associated with the arrival at the earth of

large clouds of magnetized solar plasma. The large scale of the phenomenon indicates that the clouds expand significantly while crossing the solar system. An interpretation is given based on the assumption that the plasma is magnetically turbulent. Cosmic rays enter the cloud, then execute a random-walk motion in space. While within the expanding cloud they must lose energy in an inverse Fermi mechanism and by betatron action in the weakening magnetic field. The energy spectrum within the cloud is depressed below the galactic spectrum. The spectrum is calculated in the isotropic approximation using age-diffusion theory, considering only the effects of spatial diffusion and energy loss. Convection is neglected. Several prominent features of observed decreases are thereby accounted for, i.e., the time profile, the magnitude, and the approximate rigidity dependence. (auth)

29622 THE MAGNETIC FIELD OF THE QUIET-TIME PROTON BELT. Syun-Ichi Akasofu (Univ. of Alaska, College), Joseph C. Cain, and Sydney Chapman. J. Geophys. Research, 67: 2645-7(July 1962).

The distortion of the earth's magnetic field produced by the proton belt is discussed. The magnetic field is calculated numerically, to a first approximation, for an analogous model belt in a steady state. It is estimated that in the equatorial plane, at the earth's surface, the magnetic field produced by this belt is of the order of 38 γ ($\gamma = 10^{-5}$ Oe). It is directed southward. The maximum field reduction is of the order of 72 γ at 4.1a (a = earth's radius); this is 15.5 per cent of the dipole field intensity at this point. Beyond 6.7a, the belt increases the earth's field. (auth)

29623 A CHARGE SEPARATION MECHANISM FOR THE PRODUCTION OF POLAR AURORAS AND ELECTROJETS. J. W. Kern (Rand Corp., Santa Monica, Calif.). J. Geophys. Research, 67: 2649-65(July 1962).

A mechanism for charge separation in the geomagnetically trapped radiation is described that may account for some observed phenomena associated with polar auroras and electrojet current systems. Surfaces of constant number density may be separated from surfaces of constant integral invariant within the trapped radiation as a result of distortion of the geomagnetic field by solar streams. Drift separation of protons and electrons follows, and, for irregular distributions of plasma number density, electric fields arise. A direct consequence of such polarization of the geomagnetically trapped radiation is the polar-electrojet current systems. Polar auroras arise where energetic particles are discharged from regions of excess charge within the geomagnetically trapped radiation. A model for the discharge of such auroral particles is discussed. One feature of the proposed mechanism is that thinness of auroral sheets appears to follow as the natural consequence of charge separation. This is shown analytically for a simple two-dimensional model of a trapped plasma. (auth)

29624 AN EXTREMELY INTENSE ELECTRON FLUX AT 1000-KILOMETER ALTITUDE IN THE AURORAL ZONE. B. J. O'Brien and C. D. Laughlin (Iowa State Univ., Iowa City). J. Geophys. Research, 67: 2667-72(July 1962).

The radiation-research satellite Injun I passed through an extremely large electron flux, at 1000 km altitude and high latitudes, around 2238 UT on September 25, 1961. The peak flux was 400 ergs $(cm^2\ sec\ ster)^{-1}$ from electrons with energy above 1 kev and 10^8 particles $(cm^2\ sec\ ster)^{-1}$ with energy above 40 kev. The electron flux varied greatly both in intensity and spectral character during the satellite pass. For example, the intensity changed by a factor of about a million in a time of about 30 seconds or a distance of several hundred kilometers. The electron spectrum changed so greatly and so rapidly that, if a differential power-law spectrum was applied, values of the exponent ranged between above 4 and more than 14. At this time, the electron flux was measured with similar detectors on Explorer XII in the heart of the outer zone on the same magnetic shell but at a different longitude. Since the electron intensity and spectrum measured by Explorer XII were normal, the anomalous flux seen by Injun was confined in longitude. The Injun observations indicated that the flux was essentially isotropic over the upper hemisphere. The energy flux was sufficient to cause a very bright aurora, and the measurements were tabulated for comparison with auroral theories. The measurements proved that an acceleration mechanism in the ionosphere was not always necessary to produce an aurora. (auth)

29625 COSMIC-RAY EXPOSURE HISTORY OF TEKTITES. Elizabeth Viste and Edward Anders (Univ. of Chicago, Ill.). J. Geophys. Research, 67: 2913-19(July 1962).

To establish whether tektites are extraterrestrial in origin, five composites including a total of 79 tektites from the Far East and Australia are examined for cosmic-ray-induced Al^{26} by γ-γ coincidence spectrometry. No activity is found in any of these samples, corresponding to 2σ upper limits for the Al^{26} content of ≤ 1.6 to ≤ 8 dpm/kg, or about ≤ 3 to ≤ 13 per cent of Al^{26} content of meteorites. A grand composite of all the above samples shows a marginal positron activity corresponding to an Al^{26} content of 0.48 ± 0.26 dpm/kg, but this activity can apparently be accounted for by reactions of cosmic-ray secondaries at the surface of the earth with silicon and aluminum in the tektites. No evidence is found for a preterrestrial exposure to cosmic rays. These results do not completely rule out an extraterrestrial origin but do place the following restrictions on it: if the tektites arrive as small, unshielded bodies, their "flight" or cosmic-ray exposure time must have been less than 90,000 years; if they arrive in a large, well-shielded body, this "prototektite" body must have had a radius of ≤ 54 meters. (auth)

29626 D-REGION IONIZATION BY SOLAR X RAYS. I. G. Poppoff and R. C. Whitten (Stanford Research Inst., Menlo Park, Calif.). J. Geophys. Research, 67: 2986-8 (July 1962).

From measurements of the solar background x-ray spectra at 2 to 60 Å, taken under quiescent solar conditions during periods of sunspot maximum, a calculation is made of the rate of electron production in the atmosphere by x-ray ionization at 70 to 90 km. For this production rate and the dissociative recombination coefficient, the electron concentration in the atmosphere from 70 to 90 km is calculated. It is noted that factors other than x-ray ionization also contribute to the D-region ionization. (T.F.H.)

29627 PRODUCTS OF COSMIC RADIATION IN THE SIKHOTE-ALIN METEORITE. E. K. Gerling and L. K. Levskii. Meteoritika, 18: 100-5(1960). (In Russian)

The determination of: the isotope content of He, Ne, and Ar; changes in content of the cosmogenic product of a large sample; and the content of inert gases in separate samples of meteorite fallout is described. The method of determination is described graphically. The results of the analysis of 25 samples for Ar^{36}, Ar^{38}, Ar^{40}, He, He^3, He^4, Ne, Ne^{20}, Ne^{21}, Ne^{22}, and their ratios are tabulated and discussed. (Meteorol. Geoastrophys. Abstr., 13: (Mar. 1962).)

JULY 10, 1959 FLARE. S. Biswas (Univ. of Minnesota, radiation are associated with the arrival at the earth of

29628 DER EINFLUSS DES GEOMAGNETISCHEN FELDES AUF DIE KOSMISCHE STRAHLUNG. (Influence of the Geomagnetic Field upon Cosmic Radiation). Abhandlungen, No. 23. W. Conrad. Potsdam, Germany, Geomagnetisches Institut, 1959. 180p.

Literature on cosmic radiation is reviewed. The nature and behavior of cosmic radiation is studied, with descriptions of cosmic ray primaries (positive and negative components), secondary radiation, and cosmic radiation in the atmosphere (multiplying effect and absorption, atmospheric cut-off, albedo, and effects of pressure and temperature). Cosmic radiation in a geomagnetic field invariable with time is also treated. Theories are given, and the distribution of cosmic ray intensities over the globe is presented. Cosmic radiation in a geomagnetic field variable with time is considered, with attention to a possible solar origin of cosmic radiation; diurnal variation; 27-day cycle; 11-yr cycle; magnetic storms and intensity of cosmic radiation; and sudden surges. An "isocosmic" chart is appended, giving intensities of ionization through cosmic radiation at sea level, reduced to measurements made in Amsterdam by means of a Clay ionization chamber. (Meteorol. Geoastrophys. Abstr., 13: (Mar. 1962).)

Criticality Studies

29629 (ANL-6559) FEASIBILITY OF $Pu^{239}-U^{235}$-FUELED CORES TO PREDICT Pu^{239}-FUELED CORE DIMENSIONS. D. Meneghetti and H. Ishikawa (Argonne National Lab., Ill.). June 1962. Contract W-31-109-Eng-38. 17p.

Use of $Pu^{239}-U^{235}$-fueled fast critical assemblies to estimate properties of Pu^{239}-fueled assemblies is of interest because of safety considerations and limited plutonium availability. Bare and reflected homogeneous cores and reflected two-region cores are considered. The fuel, 5% by volume, is assumed to be Pu^{239} and U^{235} of various fuel composition ratios for the homogeneous cores. For the two-region cores the 5% fuel volume is Pu^{239} in the central region and U^{235} in the outer core region. Core diluents, simulating fertile, structural, and coolant materials, are assumed identical in all cases. It is estimated that construction of the reflected two-region core with ratio of central core region volume to total core volume of 0.1 will theoretically decrease the calculated error in prediction of the critical size of a corresponding solely Pu^{239}-fueled assembly by a factor of about 10 to 20. (auth)

29630 (ANL-6570) k CALCULATIONS FOR 22 ZPR-III FAST REACTOR ASSEMBLIES USING ANL CROSS-SECTION SET 635. W. G. Davey (Argonne National Lab., Idaho Falls, Idaho). May 1962. Contract W-31-109-eng-38. 21p.

The Yiftah, Okrent, and Moldauer cross-section set (ANL Set 135) was modified to include new measurements of ν and α for U^{235}, and to include, in an approximate manner, Hummel, Rago, and Meneghetti's corrections for flux depression at resonance energies in Al and stainless steel. This modified set, ANL Set 635, was used to compute values of k for 22 ZPR-III assemblies of widely varying composition. The DSN neutron transport code was used in spherical geometry and the S4 approximation; shape factors were used to convert from cylindrical to spherical geometry. Seventeen of the calculated values of k lie within ±1% of a mean value of 1.003, and the remaining 5 lie within ±2%. In terms of prediction of critical mass, it appears that the procedure used here can achieve an accuracy of 5% to 10% for a wide range of U^{235}-fueled assemblies. (auth)

29631 (HASL-125) THE CALCULATION OF SOME BESSEL FUNCTIONS FOR CRITICALITY PROBLEMS. Edward Katine (New York Operations Office. Health and Safety Lab., AEC). May 1962. 38p.

A method for evaluating the Bessel functions $J_0(x)$, $J_1(x)$, $I_0(x)$, $I_1(x)$, $K_0(x)$, and $K_1(x)$ is given. This method is applicable to the one-dimensional, 2-group, 2-region diffusion problem, and is designed primarily for use on a small or medium sized digital computer. Two power series are employed for the Bessel functions of the first kind. In the evaluation of the hyperbolic Bessel functions, four power series are used for small values of x while four asymptotic series are used for the large values. In the intermediate range of $3 < x < 9$ a correction factor is applied to the asymptotic series. The maximum percentage error is shown to be 0.003 when compared with accepted tables. FORTRAN programs based on this method are presented together with the output obtained from an IBM-1620 digital computer. (auth)

Elementary Particles and Radiations

29632 (BNL-735) THREE LECTURES ON ELEMENTARY PARTICLE RESONANCES. R. H. Dalitz (Brookhaven National Lab. Upton, N. Y. and Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). Dec. 1961. Contract [AT(30-2)-GEN-16]. 96p.

One lecture concerns elementary particle resonance states: including information concerning nucleon isobars, the pionic resonance states, the K-π resonant states, the hyperon isobars, and other systems. Another lecture concerns the determination of intrinsic parameters of resonance states: interference effects in Y_1^* decay, the spin parity of ω^0 and η^0 states, and resonant states with one entrance channel accessible. The third lecture concerns possible interpretations for the resonant states in which information is presented on N^* resonances and their analogs, virtual bound-state resonances, cusp-like resonances, the vector theory of strong interactions, and higher symmetries. A reference list containing 65 entries is also included. (J.R.D.)

29633 (CEA-2092) RESULTS IN PION PROTON SCATTERING NEAR THE HIGHER RESONANCES. P. Falk-Vairant and G. Valladas (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Saclay). 1961. 8p.

Information is presented on the total cross sections for pion proton scattering at 400 Mev to 1.5 Bev. All results on total cross sections for particular channels such as elastic scattering, inelastic scattering, and charge exchange are included. Using new results on the total cross section for neutral events, the cross sections for elastic and for inelastic scattering in the $T = 1/2$ state were plotted. (auth)

29634 (CRSR-117) MAGNETIC EFFECTS OF GEOMAGNETICALLY TRAPPED PARTICLES. Martin Lester Dwarkin (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). May 1962. Contracts AF49(638)-915 and NsG 184-60. 52p. (AFOSR-3003)

A means of calculating the magnetic field produced by the motion of geomagnetically trapped particles due to an arbitrary distribution of trapped particles at a point which is not in the trapping region is described. Calculations were made of the fields at the surface of the earth due to narrow belts of trapped particles. The importance of various harmonics is illustrated. It was found that particle motion around the equatorial plane in the trapping region

is the principal source of magnetic field due to trapped particles. The magnetic field throughout the earth due to particles trapped on dipole shells is essentially uniform. (M.C.G.)

29635 (EFINS-62-9) THE NUCLEAR INTERACTIONS OF THE HYPERONS. R. H. Dalitz (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). [1961]. Contract [AT(11-1)-264]. 144p.

Lectures on the present evidence on hyperon-nucleon interactions are presented. Topics covered include: data on Λ-hypernuclei, the phenomenological analysis of binding energy data for hypernuclei, the spin dependence of the Λ-nucleon interaction, theory of hyperon-nucleon forces, hyperon-nucleon scattering and reaction processes, the decay modes of the light hypernuclei, and some problems to be solved concerning hypernuclei. (M.G.C.)

29636 (JINR-D-1004) SYMMETRY OF STRONGLY INTERACTING SYSTEMS WITH HYPERCHARGE Y = 0. A. M. Baldin and A. A. Komar (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 6p.

The mathematical formalism necessary to describe the symmetry of hyperneutral systems, or systems of strongly interacting particles with the total hypercharge Y = 0 whose characteristics are independent of the isotopic spin value T, is presented. Different selection rules following from this symmetry are discussed. (M.C.G.)

29637 (JINR-D-1016) INVERSION OF HELICITY IN NUCLEAR REACTIONS. N. P. Klepikov and Ya. A. Smorodinskii (Smorodinsky) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 9p.

It was previously shown that the cross section of the scattering of a particle with spin $\frac{1}{2}$ by a spinless target remains invariant under the transposition of the phase shifts of all pairs of states belonging to the same total angular momentum. Generalization of this transformation is discussed. Two successive transformations lead to the inversion of the helicity of all particles. For systems with integral spin Minami transformation and inversion of helicity do not change the parity of the states, while for systems with half-integral spin parity changes. Processes occurring in a collision of a polarized beam with a polarized target were considered. (M.C.G.)

29638 (JINR-E-983) NON-LINEAR SCALAR FIELD THEORY. D. I. Blokhintsev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 8p.

A model of the non-linear scalar field theory is discussed. This model allows an existence of some kinds of particles, while the vacuum is degenerate. The vacuum degeneration leads to an appearance of additional vacuum excitations which are represented by particles with very small masses, whereas the presence of potential barriers in the functional space leads to the possibility of radioactive decay of elementary particles. The problem, its approximate solution with the aid of the spatial lattice, and the radioactive decay of particles are discussed. (M.C.G.)

29639 (JINR-P-1011) SOVMESTNYI FAZOVYI ANALIZ NUKLON–NUKLONNOGO RASSEYANIYA PRI ENERGIYAKH 40, 95, 147, 210, 310 Mev. (Combined Phase Analysis of Nucleon–Nucleon Scattering at 40, 95, 147, 210 and 310 Mev). Yu. M. Kazarinov and I. N. Silin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 22p.

The phase analyses of nucleon–nucleon scattering at 40, 95, 147, 210, and 310 Mev were made and the results compared with data given by Yu. M. Kazarinov, JINR-P-970, Dubna, 1962, for 40, 95, 147, and 310 Mev. The magnitudes of matrix transition elements for the first and second phase shifts were measured in order to simplify further calculations and correlations. (R.V.J.)

29640 (LNF-62/62) PHOTOPRODUCTION AND RADIATIVE DECAY MODE OF THE 550 Mev PION RESONANCE (η PARTICLE). Note No. 152. C. Mencuccini, R. Querzoli, G. Salvini, and V. Silvestrini (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). July 14, 1962. 12p.

Experimental evidence in favor of the existence of the photoproduction process $\gamma + p \rightarrow (\eta \text{ and/or } \zeta^0) + p$ with the produced particle decaying into a radiative mode ($\gamma + \gamma$ or $\pi^0 + \gamma$) is reported. The cross section observed for this process is of the order of 3 to 5×10^{-32} cm^2/ster. (auth)

29641 (NASA-TN-D-1115) NUCLEAR RADIATION TRANSFER AND HEAT DEPOSITION RATES IN LIQUID HYDROGEN. M. O. Burrell (National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.). Aug. 1962. 96p.

Stochastic methods are used to calculate the radiation transport and energy deposition of neutrons and gamma rays in liquid hydrogen slabs and cylinders. The sources are treated as monoenergetic and either point isotropic for the cylinder or plane parallel rays for the slabs. A description of the methods used and a rather extensive compilation of results are given. The results include heat rate deposition as a function of depth, albedo factors, slow neutron spatial distributions, and transmitted angular distributions of gamma rays. (auth)

29642 (NEVIS-100) [PROGRESS REPORT ON PHYSICS]. Final Report. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Cyclotron Labs.). Jan. 1962. Contracts N6-ori-110 and AT(30-1)-1932. 36p. (CU-207; R-314)

Progress on physics research at the Nevis Cyclotron Laboratory is reviewed. Early pion experiments, first order refinements, mesic x rays, weak interactions, and other studies using the cyclotron are discussed. (M.C.G.)

29643 (NP-11605) DANNYE O π-π VZAIMODEISTVII IZ REAKTSII ROZHDENIYA π MEZONOV V π-P SOUDARENIYAKH. II. (ROZHDENIE ρ^0 MEZONA). (Data on π-π Interaction in Pion Production in π-p Collisions. II. (Production of ρ^0 Mesons)). Ya. Ya. Shalamov and A. F. Grashin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 11p.

A 17-liter bubble chamber was used in an investigation of $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ reactions on free or quasifree protons in a C_3H_8 + Xe working mixture at an initial π^- energy of 2.8 ± 0.3 Bev/c. Strong π-π interactions were observed at $\omega = M_{\pi\pi} \simeq 0.8$ Bev and $\omega \simeq 1.4$ Bev. The first resonance was found at $\sim\cos^2 \varphi^*_\pi$ angular distribution in the two-π center-of-inertia in relation to an initial direction that is equivalent to polarized vector ρ-meson production. The probability of two-meson mass production, $0.35 \leq M_{\pi\pi} \lesssim 0.5$ Bev, does not exceed a small percentage of the total process cross section. (tr-auth)

29644 (NP-11900) PHOTOMESON PRODUCTION FROM NEUTRONS BOUND IN HELIUM AND DEUTERIUM. Technical Report No. 41. Arthur B. C. Walker, Jr., James H. Smith, and Louis J. Koester, Jr. (Illinois. Univ., Urbana. Physics Research Lab.). June 1962. Contract ONR 1834 (05). 147.

Photomeson production from neutrons bound in He and deuterium was investigated by simultaneously measuring the angle and energy of the meson and the recoil proton.

270-Mev bremsstrahlung was used and, in this experiment, only pions at 75° in the laboratory were measured. This corresponds roughly to 90° in the center of mass system of the photon and struck neutron. The angular distributions were interpreted to give the internal nuclear momentum distribution of the parent neutron by comparing the experimental data with a calculation based on the impulse approximation. The deuterium data agree both in shape and in absolute magnitude with predictions based on the Hulthén wave function. The He data indicate that the neutrons involved in photomeson production have fewer high momentum components in their wavefunctions than those found from other types of experiments. This result is interpreted as evidence for the reabsorption of mesons by the parent nucleon and another nucleon interacting strongly with it to produce pseudodeuteron photodisintegrations. These strong two body interactions are believed responsible for the high momentum components of the internal nuclear momentum distribution. (auth)

29645 (NP-11901) RESIDUAL FORCES IN SINGLE-PARTICLE MODELS. R. A. Sorensen (Buenos Aires. Universidad. Facultad de Ciencias Exactas, Fisicas y Naturales). July 1961. 69p.

A review of nuclear models is presented and it is noted that a good detailed model should agree with the static electric and magnetic momements of nuclear levels, with electromagnetic β-decay, with particle transition rates between levels, and with the separations of the energy levels. The commonly used standard is the single particle moment or transition rate. This single particle estimate is the expected value on the basis of the non-interacting shell model. Various aspects of the shell model are discussed including the single particle configuration, angular momentum in quantum mechanics, Nilsson's model, and residual forces. (J.R.D.)

29646 (NP-11927) RESEARCH ON THE PRODUCTION OF MESONS IN LIQUID HYDROGEN BUBBLE CHAMBER. Final Technical Report, June 1, 1959–May 31, 1962. Edwin L. Goldwasser (Illinois. Univ., Urbana). Contract AF 49 (638)-594. 8p.

Activities in a program to obtain reliable data on photoproduction of π mesons in the region near the threshold are reported. A run using x rays with the bubble chamber filled with liquid H was completed along with a similar run using deuterium. Analysis of the pictures which were obtained in both runs is in progress and publication of results is planned. (J.R.D.)

29647 (NP-11950(Vol.I)) LECTURES ON HIGH ENERGY PHYSICS DELIVERED AT THE SIXTH SUMMER MEETING OF NUCLEAR PHYSICISTS, JULY-AUGUST 1961, HERCEGNOVI, YUGOSLAVIA, VOLUME I. B. Jakšić, ed. (Yugoslavia. Nuclear Energy Commission, Belgrade). 281p.

Six lectures on high energy physics delivered at the Sixth Summer Meeting of Nuclear Physicists, July to August 1961, Hercegnovi, Yugoslavia are given. Separate abstracts were prepared for 5 lectures. One was previously abstracted for NSA. (M.C.G.)

29648 (NP-11950(Vol.I)(p.1-66)) MATHEMATICAL THEORY OF POTENTIAL SCATTERING. Tullio Regge (Turin. Universita. Istituto di Fisica).

A study was made to find those features of potential scattering which are to a large extent independent of the particular selection of the potential. The theory of potential scattering is discussed. Topics covered include: the S-wave, analytic properties of Jost's function, pology of $S(\kappa)$, Yukawian potentials and the restricted case of S-waves, the higher waves, Levinson's theorems, the techniques of complex angular momenta, the Jost functions and analytic properties of the partial wave functions, the asymptotic behavior of the phase shift, the poles of $S(\lambda,\kappa)$, the total amplitude and the Lehmann ellipse, analyticity in t for fixed s, and the results of Khuri. (M.C.G.)

29649 (NP-11950(Vol.I)(p.113-72)) INTRODUCTION TO PION PHYSICS. Ernesto Corinaldesi (Pisa, Italy. Università) and Marcello Cini (Rome. Università).

Topics covered in the discussion of pion physics include: one-particle states, T matrix, isospin formalism and charge independence, experimental tests of charge independence, photoproduction transition operator, meson (π)-nucleon scattering, meson (π) photoproduction, relation between scattering and photoproduction, and phenomenological analyses of meson (π)–nucleon scattering and meson (π) photoproduction. (M.C.G.)

29650 (NP-11950(Vol.I)(p.173-207)) INTRODUCTION TO THE STATIC MODEL. Walter Thirring (Vienna. Universität. Institut für Theoretische Physik).

The static model for the interaction of the three pions with spin and iso-spin of a fixed nucleon is discussed. Topics covered include: the Hamiltonian, the free nucleon classically, classical treatment of scattering, quantum theory of scattering, diagonalization of the T matrix, and an approximate solution of the Low equations. (M.C.G.)

29651 (NP-11950(Vol.I)(p.208-60)) THE HELICITY FORMALISM — A NEW APPROACH TO POLARIZATION PROBLEMS. Maurice Jacob (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

A method for handling polarization problems was developed. The formalism employed relies on unitarity, conservation laws, and composition law for angular momentum. Two-body collisions of the type $a + b \rightarrow c + d$ were considered. The different polarization states of a particle are labeled by the component λ of the spin along the direction of motion of the particle, this component is called the helicity of the particle. The helicities are used instead of the total spin and the orbital angular momentum. The formulas for intensity and polarization using these simplifications involve fewer vector-addition coefficients and no recoupling coefficients construction of the helicity eigenstates is shown. Examples of the use of these states in the general S matrix formalism for determining polarization are presented. (M.C.G.)

29652 (NP-11950(Vol.I)(p.261-74)) ANALYSIS OF PION-NUCLEON INTERACTION FROM 500 TO 1500 Mev. Maurice Jacob (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

Data obtained on pion-nucleon interactions at 400 to 1500 Mev are discussed. Other experimental data needed are described. Photoproduction, π^--p scattering, and pion production are discussed. (M.C.G.)

29653 (NP-11950(Vol.II)) LECTURES ON HIGH ENERGY PHYSICS DELIVERED AT THE SIXTH SUMMER MEETING OF NUCLEAR PHYSICISTS, JULY-AUGUST 1961, HERCEGNOVI, YUGOSLAVIA. VOLUME II. B. Jakšić, ed. (Yugoslavia. Nuclear Energy Commission, Belgrade). 246p.

Four lectures on high energy physics presented at the Sixth Summer Meeting of Nuclear Physicists, July to August 1961, Hercegnovi, Yugoslavia are given. Separate abstracts were prepared for 3 of the lectures. One was previously abstracted for NSA. (M.C.G.)

29654 (NP-11950(Vol.II)(p.275-354)) ANALYTICITY PROPERTIES OF SCATTERING AMPLITUDES AND APPLI-

CATIONS TO PION PHYSICS. Marcello Cini and Bruno Vitale (Rome. Università).

Integral representations are given for the scattering amplitude. Analytic properties of the scattering amplitude and of T as a function of energy and momentum transfer are described. A one-dimensional approximation to the Mandelstam representation is presented. The Chew-Mandelstam approach to π-π scattering is outlined. Applications of one-dimensional and two-dimensional dispersion relations to pion-nucleon and nucleon-nucleon scattering are discussed. The quantum field theory for photoproduction is also outlined. (M.C.G.)

29655 (NP-11950(Vol.II)(p.355-424)) MISCELLANEOUS TOPICS ON DISPERSION RELATIONS FOR PROBLEMS INVOLVING PHOTONS. Michel Gourdin ([Paris. Université, Orsay. Ecole Normale Supérieure. Faculté des Sciences]).

Three applications of the Mandelstam representation are discussed: the photoproduction of pions on pions, the nucleon and pion electromagnetic form factors, and the photoproduction of pions on nucleons. Topics covered include: invariance properties of the matrix elements, Mandelstam representation, reduction of the integral equation to a Fredholm type equation, bipion model approach, determination of the coupling constant, pion electromagnetic structure, invariance properties and dispersion relation approach for nucleon electromagnetic form factors, multipole expansion in the photoproduction channel, unitarity condition for the isoscalar amplitudes, bipion model approach for the isoscalar amplitudes, and isovector amplitudes. (M.C.G.)

29656 (NP-11950(Vol.II)(p.425-84)) ON THE THEORY OF ELEMENTARY PARTICLE REACTIONS. Reinhard Oehme (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies).

Bound states and the description of resonances are discussed in connection with the continuation of scattering amplitudes and form factors through two-particle branch lines. The compound structure of particles was considered. It is shown that the structure manifests itself within the framework of the relativistic dispersion theory. Continuation of scattering amplitudes through two-particle branch lines, resonances for elastic scattering, several two-particle channels, applications to hyperon scattering, form factors and inelastic amplitudes, and compound structure are discussed. (M.C.G.)

29657 (NP-11978) ΄ππ-VZAIMODEISTVIE VO MNOZHESTVENNOM ROZHDENII π-MEZONOV V π^--p STOLKNOVENIYAKH. ($\pi\pi$-Interaction in Multiple Pion Production in π^--p Collisions). M. S. Ainutdinov, S. M. Zombkovskii, S. Ya. Nikitin, Ya. M. Selektor, and V. N. Shulyachenko (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1962. 15p.

Multiple π production in π-p interactions at 7.2 Bev was measured in a 25-cm liquid-hydrogen bubble chamber in a 13.5 k gauss magnetic field. The π mesons formed in an internal synchrophasatron target were focused by quadrupole lenses, magnetic analysis was achieved by means of a deflecting magnet. The beam dimensions at the entrance were 15 × 8 cm, mean π-meson energy was 7.2 Bev. π dispersion is described by a gaussian distribution with a half-width of 0.8 Bev. (R.V.J.)

29658 (NP-11992) PHOTOPRODUCTION OF 42.4 Mev POSITIVE PIONS FROM HYDROGEN AT LABORATORY ANGLES BETWEEN 50 AND 170 DEGREES. Technical Report No. 40. Paul M. Baum and Clark S. Robinson (Illinois. Univ., Urbana. Physics Research Lab.). July 1962. Contract ONR 1834(00). 180p.

Relative differential cross sections for the photoproduction of 42.4 Mev π^+ mesons from hydrogen were measured at twelve laboratory angles between 50° and 170°. The mesons were produced in a liquid hydrogen target which was irradiated by the bremsstrahlung beam of a 300 Mev betatron. The pions were momentum-selected by a magnetic spectrometer and detected and counted by a scintillation counter telescope. Since the pion energy was held constant with angle, several types of errors which vary systematically with angle were avoided. The relative cross sections were measured to about 1 per cent statistical accuracy. Possible systematic errors are less than 3 per cent. The experimental cross sections obtained are compared with the predictions of the dispersion theory of Chew, Goldberger, Low, and Nambu, (CGLN). It is found that an appreciable discrepancy exists. When the experimental results are normalized to the theoretical cross section at the smallest angle, the theoretical values at large angles are about 28 per cent higher than the experimental values. This experimental behavior can be predicted by the inclusion of the rho-meson, or bipion, interaction in the photoproduction amplitude. Comparison with the theoretical results of McKinley shows that the data can be fitted quite well by using a rho-meson coupling constant $A/ef = -1.2 \pm 0.4$. The uncertainty in A is due to the uncertainty in the phase shifts appearing in the photoproduction amplitude. (auth)

29659 (NYO-10236) EXACTLY SOLVABLE CASES OF REGGE POLES FROM MANDELSTAM REPRESENTATION. R. Acharya (Rochester, N. Y. Univ.) and A. Bhattacharjie (Rochester, N. Y. Univ. Inst. of Optics). June 21, 1962. Contract AT(30-1)-875. 13p.

Starting from the Mandelstam representation in potential scattering, explicit examples are given for which the Regge function $R(\Delta,\lambda)$ is known exactly. In particular, a symmetry property of $R(\Delta,\lambda)$ at integral λ is derived. The nature of "kinematical" and "dynamical" Regge poles is discussed in some detail. Finally, the potentials responsible for the various cases are written down in Born approximation. (auth)

29660 (TID-16119) RESEARCH IN HIGH ENERGY NUCLEAR PHYSICS. (Harvard Univ., Cambridge, Mass. Lyman Lab. of Physics). May 23, 1962. Contract AT(30-1)-2752. 27p.

Progress is reported on bubble chamber studies, scattering experiments, and target polarization. The Θ^0 and Λ^0 branching ratios, π^0 production by 960-Mev π^- were studied and a search for dipion ($\pi^-\pi^0$) particle was made using the bubble chamber. Procedures used in analysis of film of bubble chamber events are described. Construction of components for bubble chamber systems is proceeding. Scattering experiments were planned for the Cambridge Electron Accelerator Magnetic spectrometers were designed for use in these studies. Theories were developed and apparatus was designed. Experiments developed are outlined. Conditions for operation of a polarized target were studied. (M.C.G.)

29661 (UCRL-10107) MEASUREMENT OF G/M FOR MUONS (thesis). Gordon McDonald Bingham (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1962. Contract W-7405-eng-48. 129p.

A free running "muon stroboscope" was used to measure the ratio of the precession frequencies of muons (f) and protons in water (f_p) for the same magnetic field. The stroboscope frequency was 200 Mc/sec. The results obtained were: Positive muons stopping in bromoform $(f/f_p)^+ = 3.18336 \pm 0.00007$, and negative muons stopping in water $(f/f_p)_{H_2O}^- = 3.1808 \pm 0.0004$. The first ratio is as-

sumed to be also that of the free particles and leads to the values; $(g/m)^+ = (9.6840 \pm 0.0002) \times 10^{-3}\ m_e^{-1}$ and $m^+ = (206.766 \pm 0.005)m_e$ where m_e is the electron mass. A diamagnetic correction is applied to the second ratio and the equivalent value $(g/m)^-_{H_2O}$ obtained for negative muons stopping in water is $(g/m)^-_{H_2O} = (9.6760 \pm 0.0013) \times 10^{-3}\ m_e^{-1}$. Assuming equal masses for positive and negative muons the solution $[g^-(H_2O) - g^+/g^+] = -(8.3 \pm 1.4) \times 10^{-4}$ is obtained. Results are in reasonable agreement with the recent Columbia experiment of Hutchinson et al. (auth)

29662 (UCRL-10214) NUCLEAR FISSION INDUCED BY RADIATIONLESS TRANSITIONS IN THE MU-MESONIC ATOMS Th^{232}, U^{235}, AND U^{238} (thesis). Justo A. Diaz (California. Univ., Berkeley. Lawrence Radiation Lab.). May 9, 1962. Contract W-7405-eng-48. 57p.

The time distribution of fissions in Th^{232}, U^{235}, and U^{238} induced by mesons(μ^-) was measured with a multiplate gas-scintillation fission chamber. A significant number of prompt fissions that are not associated with meson(μ^-) nuclear capture were observed. The work of Mukhin et al. shows that the intensities of μ-mesic K x rays for these elements relative to Pb are 0.85 ± 0.0 (Th^{232}), 0.77 ± 0.04 (U^{238}), and 0.71 ± 0.05 (U^{235}). This intensity reduction is qualitatively consistent with earlier predictions that, for these elements, a direct excitation of the nucleus competes with electromagnetic radiation in the transition to the ground state of the mesic atom. Results of measurements in this report indicate such direct nuclear excitation. The number of fissions observed can be made quantitatively consistent with the results of Mukhin et al. and with photofission data when the effect on the fission barrier of the meson(μ) in the 1S state of the mesic atom is taken into consideration. (auth)

29663 (UCRL-10290) A TEST OF ISOTOPIC SPIN CONSERVATION IN STRONG INTERACTIONS FROM AN EXPERIMENTAL LIMIT ON $\sigma(d + d \rightarrow He^4 + \pi^0)$ (thesis). Morris Pripstein (California. Univ., Berkeley. Lawrence Radiation Laboratory). June 1962. Contract W-7405-eng-48. 74p.

The reaction $d + d \rightarrow He^4 + \pi^0$, which is forbidden by isotopic spin conservation, was looked for at the Berkeley 184-inch cyclotron. A beam of deuterons of 460-Mev kinetic energy was scattered from an extended target filled with deuterium gas at a pressure of 390 psi (abs) and at liquid N temperature. The differential cross section in the center-of-mass system at about $\Theta_{c.m.} = 90$ deg was measured and an upper limit of 1.5×10^{-34} cm^2/sr was obtained. The data are consistent with no π^0 production. From a comparison of this upper limit with the theoretical prediction of the cross section for this reaction if isotopic spin need not be conserved, it is concluded that isotopic spin is at least 99.6% conserved in strong interactions. The reaction $d + d \rightarrow He^4 + \gamma$ was also looked for and an upper limit for the differential cross section in the center-of-mass system at $\Theta_{c.m.} = 65$ deg of 3.5×10^{-34} cm^2/sr was obtained. The data are consistent with no γ production. (auth)

29664 (UCRL-10384) FORTRAN PROGRAM TREGGE. Philip G. Burke and Cecil Tate (California. Univ., Berkeley. Lawrence Radiation Lab.). July 24, 1962. Contract W-7405-eng-48. 20p.

A Fortran program called TREGGE for an IBM-7090 computer is described. The program calculates Regge trajectories and S-matrix elements for an arbitrary potential. (auth)

29665 (UNC-5014(Vol.A)) METHODS IN MONTE CARLO SOLUTION OF THE RADIATION TRANSPORT EQUATION. Final Report, March 20, 1961–May 31, 1962. M. H. Kalos (United Nuclear Corp. Development Div., White Plains, N. Y.). May 31, 1962. Contract DA-18-108-405-CML-1007. 45p. (NDL-TR-36(Vol.A))

A discussion is given of certain methods of importance sampling and scoring in the Monte Carlo solution of the radiation transport equation. (auth)

29666 (AEC-tr-5225) MEASURING THE SPECTRA OF TRITONS IN NUCLEAR REACTORS. A. A. Ogloblin and V. I. Chuev. Translated from p.191-200 of "Proceedings of a Symposium on Tritium in the Physical and Biological Sciences, held in Vienna, May 3-10, 1961. Vol. I" (a publication of the International Atomic Energy Agency, Vienna, 1962). (STI/PUB/39(Vol.I(p.191-200))). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 16090.

29667 (AERE-Trans-896) ASYMPTOTIC EXPANSION OF THE WAVE FUNCTION OF CHARGED PARTICLES. R. Pēterkops. Translated by J. Caldwell (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England) from Latvijas PSR Zinātņu Akad. Vēstis, No. 9(158), 79-84(1960). 10p.

An investigation is reported concerning the behavior of the wave function which describes collisions of 3 or more charged particles. In the analysis, a collision between an electron and an atom or positive ion is considered. (J.R.D.)

29668 (FTD-TT-62-846) RADIATION OF ULTRA-LIGHT SPEED CHARGED PARTICLES AND ITS UTILIZATION IN THE PHYSICS OF HIGH ENERGY PARTICLES. P. A. Cherenkov. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 14-20(Jan. 1962). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 12340.

29669 (UCRL-Trans-283(L)) ON THE γ TO PARTICLE DISCRIMINATION IN THE PARTICLE PHOTOGRAPHIC METHOD. Pierre Cuer and Henri Braun. Translated by William L. Reed (California. Univ., Livermore. Lawrence Radiation Lab.) from Compt. rend. 242: 486-9(Jan. 23, 1956). 18p.

The ideas of P. Cuer on the granular dispersion of latent images of various radiations were found to apply to the corpuscular problems of γ, α and α, p, or β, α and β, p discriminations. There are obtained, with emulsions Ilford C2 and E1, at 50μ, some α and p tracks in an acceptable fog below a maximum γ intensity of the order of 30,000 r and β (fast) tracks of the order of $\sim 2 \times 10^{11}$ per cm^2. For the Ilford G5 ~1000 r can be accepted. (auth)

29670 (UCRL-Trans-848(L)) MOLECULAR ORIENTATION AND THE EXCITATION AND DISSOCIATION PROBABILITY OF THE HYDROGEN MOLECULE BY ELECTRON IMPACT. Nobuji Sasaki and Tsuneyo Kakoa. Translated by F. S. Baker (Univ. of California, Lawrence Radiation Lab.) from Proc. Imp. Acad. (Tokyo), 11: 413-15(1935). 5p.

Details of an experiment are reported in which it was shown that the ionization probability of the H_2 molecule by electron impact becomes larger as its molecular axis approaches the direction of the electron path. (J.R.D.)

29671 STUDY OF THE Σ^+ HYPERONS CREATED BY THE COLLISIONS OF 1035-Mev π^+ MESONS ON PROTONS. Pierre Granet (Centre d'Etudes Nucleaires, Saclay, France). Compt. rend., 255: 282-4(July 9, 1962). (In French)

Forty-six cases of associated Σ^+K^+ creation permitted

the study of the branching ratios in the disintegration of the hyperon, its angular distribution, its mean life time, and the quantities $\alpha^0 P$ and $\alpha^+ P$ intervening in the decay of Σ^+. (tr-auth)

29672 THE GELFAND-LEVITAN EQUATION AND ITS APPLICATION TO THE SCATTERING OF NEUTRONS ON PROTONS. M. Blažek (Physics Lab., Slovak Academy of Sciences, Bratislava). Czechoslov. J. Phys., 12: 249-57 (1962). (In English)

The Gelfand-Levitan equation for the kernel $P(r,r')$ (with $r \geq r'$) is formulated and then applied for determining the scattering potential in the scattering of slow neutrons on protons (for the case when the dependence of the nuclear forces on the spins can be neglected and only s-scattering need be considered). The potentials obtained are the same as the Bargmann ones, but found by a different method. (auth)

29673 EXPLICIT DETERMINATION OF A POTENTIAL WITH n BOUND STATES BY MEANS OF THE SOLUTION OF THE INVERSE PROBLEM. M. Blažek (Physics Lab., Academy of Sciences, Bratislava). Czechoslov. J. Phys., 12: 258-63(1962). (In English)

A potential having n bound states is obtained for a Jost function f(k), given as the ratio of two polynomials of the order n in the impulse k, by solving the Gelfand-Levitan equation. The special case when the parameters have such values that no bound state need be considered, is studied separately. In the cases studied, the linear integral Gelfand-Levitan equation is transformed to n linear inhomogeneous algebraic equations for n unknown quantities, by means of which one can determine the potential and the solution of the Schrödinger equation. For $n = 1$ the results agree with those previously known. (auth)

29674 I. PHOTOPRODUCTION AND ELECTROPRODUCTION OF PIONS AS A POSSIBLE WAY TO MEASURE THE ELECTROMAGNETIC STRUCTURE OF THE PION. II. COHERENT PHOTOPRODUCTION OF π^0 MESONS FROM DEUTERIUM. Fokion Timoleon Hadjioannou (Stanford Univ., Calif.). Dissertation Abstr., 23: 266-7(July 1962).

I. The photoproduction process according to the pole and the possibility of an extrapolation procedure is considered. Contributions from other processes and their interference to the pole term are calculated. The interference terms are found small, and simple arguments for this are given. The effect of the peripheral γ-3π interaction is also considered. The measurement of the electromagnetic structure of the pion, based on the electroproduction process $e + P \rightarrow e + \pi + ?$ and the related crossed process $P + \bar{\pi} \rightarrow e + \bar{e} + ?$ is considered. II. The calculation of elastic photoproduction of π^0 mesons from deuterium, $\gamma + D \rightarrow \pi^0 + D$, was carried out in the impulse approximation at photon energies around 500 Mev. The single nucleon photoproduction amplitudes were taken from dispersion formulas and were corrected for kinematic effects due to internal momentum of the nucleons in the deuteron. The D-state part of the deuteron wave function is included and different models with Yukawa type or repulsive core wave functions used. Formulas connecting the cross section with the deuteron form factors are given. For small momentum transfers the formulas are, model independent and reduce to the usual ones. The presence of a 7% D-state in a repulsive core model leads to a cross section which falls typically more slowly at a momentum transfer 2.74 f^{-1}; the cross section is larger by about 40% than the cross section calculated in the absence of the D-state. The experimental points favor this model.

29675 DISPERSION RELATIONS AND PION-NUCLEON SCATTERING. Keiser Hantze Ruei (Syracuse Univ., N. Y.) Dissertation Abstr., 23: 269(July 1962).

It is shown that the scattering amplitude, where unstable particles may be produced in the intermediate states, is unitary and satisfies a dispersion relation. For sufficiently small coupling constant λ, the amplitude can be expanded in a power series of λ, which converges in the physical energy region. The series can be generated in a unique way by alternate applications of dispersion relations and unitarity conditions and can be continued analytically into large λ where it diverges but is still well defined and summable. The pole of the sum, which is always in the unphysical energy region, denotes a bound state. The analytic properties of the amplitude are discussed, as a function of the coupling constant. It is surmised that the failure of the perturbation theory in the pion-nucleon interactions is not due to the largeness of the coupling constant but due to the existence of unstable particles which can be formed by particles in the initial state and will decay into particles in the final state.

29676 THE LIFETIME OF Λ^0 HYPERON. Chuen-chuen Chang (Duke Univ., Durham, N. C.). Dissertation Abstr., 23: 272(July 1962).

A sample of 186 decaying Λ^0 particles, produced by K^- absorption in a bubble chamber, was analyzed to obtain an experimental value for the Λ^0 lifetime. The mean value of the Λ^0 momentum is 250 Mev/c. Stereo reconstruction and momentum analysis of the events were carried out on an IBM 650 computer. The momenta were determined by analysis of the Λ^0 decays, using kinematically overdetermined values of the measured angles, momenta, and ranges of the decay products. The data, along with the potential and observed path lengths of the Λ^0's in the chamber, were used to construct a maximum likelihood estimate of Λ^0 lifetime. The result was found to be $\tau = (2.60 \pm {}^{.18}_{.10}) \times 10^{-10}$ sec. The differential decay time distribution for Λ^0 was also plotted. The mean life, τ, obtained from χ^2 minimum fit to this distribution was found to be $\tau = (2.64 \pm {}^{.11}_{.10}) \times 10^{-10}$ sec. Within the error, results obtained from both methods are consistent and they are in agreement with the mean of published values of Λ^0 lifetime.

29677 DISPERSION RELATIONS FOR PHOTON-NUCLEON SCATTERING AND NUCLEON-ANTINUCLEON PRODUCTION BY PHOTONS. Andreas Panagiotis Contogouris (Cornell Univ., Ithaca, N. Y.). Dissertation Abstr., 23: 272(July 1962).

Partial wave dispersion relations for photon-nucleon scattering and nucleon-antinucleon production by photons to the order e^2 are derived with the help of the Mandelstam representation. The angular momentum decomposition for the processes $\gamma + N \rightarrow \gamma + N$ and $\gamma + \gamma \rightarrow N + \bar{N}$ is carried out and the analytic properties of the partial wave amplitudes are determined. The discontinuities along part of the physical branch cuts are calculated in terms of the unitarity condition; those along the unphysical branch cuts are calculated in terms of crossing symmetry and of analytic continuation through Legendre polynomials. The limits of convergence of the Legendre expansion are discussed and reasons for the importance of the two-pion exchange contribution in photon-nucleon scattering are presented. The differential cross-section for proton Compton scattering is then calculated at various energies in the region of and above the peak corresponding to the 3-3 pion-nucleon resonance. For this, a set of approximate dispersion relations for the scattering amplitudes is used. Small admixtures of electric quadrupole in the radiation that produces the first

photopion resonance are shown to affect the angular distribution significantly. In the region of the second photopion peak the resonant behavior is found to be reflected on the proton Compton effect. In general, the results of the calculation are in good agreement with the existing experimental data.

29678 PHOTOPRODUCTION OF PAIRS OF Pi MESONS FROM DEUTERIUM. Richard Milton Schectman (Cornell Univ., Ithaca, N. Y.). Dissertation Abstr., 23: 276(July 1962).

A high pressure diffusion cloud chamber was used in conjunction with an external gamma-ray beam of an electron synchrotron to investigate the photoproduction of pairs of pi mesons from deuterium. A 1040 Mev bremsstrahlung beam from the synchrotron was passed through the diffusion chamber, which was filled to 20 atmospheres with low-tritium-content deuterium gas, and 2 inelastic and 1 elastic pair production reactions were detected and studied. The results of the analysis of 137 such events are reported. 133 examples of the inelastic processes were observed and four cases of the elastic reaction were also seen. By application of the spectator model, the inelastic production events were interpreted as cases of pair production from single nucleons; $\gamma + p \rightarrow \pi^+ + \pi^- + p$, denoted +−(p); $\gamma + n \rightarrow \pi^+ + \pi^- + n$, denoted +−(n); and $\gamma + n \rightarrow \pi^0 + \pi^- + p$, denoted 0−(n). It was then determined from a detailed consideration of the event kinematics that the data consisted of 37 examples of +−(p), 55 examples of +−(n), and 41 examples of 0−(n). The total cross sections for the three reactions are thus expected to be comparable in order of magnitude over most of the energy range $400 < E < 1040$ Mev. Comparison of these observations with a measurement of the integrated photon flux passed through the cloud chamber showed that the total cross sections observed must also be nearly equal in size over most of the energy region investigated to the value observed previously for the photoproduction of +−(p) pairs from hydrogen (~60-80 mb). The significance of a large cross section observed for the 0−(n) process is discussed in the light of several simple models of pion pair photoproduction.

29679 MEAN LIFETIMES OF POSITRONS IN CERTAIN ORGANIC LIQUIDS AT PRESSURES TO 1250 ATMOSPHERES. George Arthur Henderson, Jr. (Univ. of Texas, Austin). Dissertation Abstr., 23: 277(July 1962).

The mean lifetimes and fractions of the long component of positron annihilation were measured in twenty-two organic liquids over the pressure range from 1 to 1250 atmospheres. The experimental technique was time-to-pulse-height conversion, employing scintillator-photomultiplier counters and a multi-channel pulse-height analyzer. The source of positrons was Na^{22}. The mean lifetimes appear to have a fairly linear dependence upon the density as the pressure is increased. The change in lifetime between different pressures is particularly apparent at the point of a phase change; three of the liquids solidified under pressure. For the most part, the fraction of long component remained fairly constant with density, especially for the liquids having lower compressibilities. However, there was a definite decrease in the fraction for the cases where a change of phase occurred.

29680 PHOTOPRODUCTION OF π AND K MESONS. V. M. Arutyunyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 15: 85-98(1962). (In Russian)

Photoproduction of π mesons and strange particles at high energies were analyzed in the peripheral interaction orientation. An analysis of π^0 photoproduction at high energies and small angles contributed a single-photon graph for the compound state. The H. Primakoff effect (Phys. Rev., 81: 899(1951)) and similar bipion and tripion resonance generation mechanisms are discussed. The photoproduction of π^+ on protons at high energies and small angles was studied using polar approximation supported by a derived single-pion exchange graph. Finally, the photoproduction of strange particles (ΛK, ΣK) was studied with the assumption of a dominant K' resonance (resonance in K-π system) contribution near the threshold at varying proton and Λ hyperon relative parities. Correlations of the results with experimental data show good agreement in the case of ΛK'p relative parity at opposite orientation to the apex. (R.V.J.)

29681 ELECTRON MOTION IN CROSSED HETEROGENEOUS ELECTRIC AND MAGNETIC FIELDS. A. M. Rezikyan and G. G. Bakhshyan (Inst. of Radiophysics and Electronics, Academy of Sciences, Armenian SSR). Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 15: 107-14(1962). (In Russian)

Studies were made of electron motion in electric and magnetic fields in coaxial cylinders. The electric field was obtained by utilizing the difference between electrode potentials, and the magnetic field was produced by the current passing the electrode core. The initial (nonzero) pitch of the loop-shaped trajectory was determined as well as the rotation frequency and the mean shift of the electron along the axis. The influence of certain parameters on the electron motion was also analyzed. A specific problem is resolved for electron motion in heterogeneous crossed fields in the space between cylindrical condensers when a round cable is the internal electrode, a hollow cylinder is the external electrode, and the initial electron velocity is different from zero. (R.V.J.)

29682 SEARCH FOR AN EFFECT OF MAGNETIC FIELDS ON ELECTROMAGNETIC RADIATION. S. S. Hanna, G. J. Perlow, J. P. Schiffer, and J. A. Weinman (Argonne National Lab., Ill.). Nature, 195: 791-2(Aug. 25, 1962).

Measurements were carried out by allowing the 14 kev γ rays emitted by Fe^{57} to pass through transverse and longitudinal magnetic fields produced by permanent magnets. In the traverse case, the magnetic field was 5500 gauss at the center of the gap traversed by the γ radiation and fell off to half this value in about 0.5 in. from the center. A frequency shift of about 5×10^{-9} was calculated. In the longitudinal field, the gap was 1700 gauss and the calculated effect was about 5×10^{-10}. From the data, the net magnetic charge on the photon is interpreted as being less than 3×10^{-38} emu. (P.C.H.)

29683 RESEARCH ON ELEMENTARY PARTICLES WITH THE HELP OF NUCLEAR EMULSION. A. G. Tenner (Universiteit, Amsterdam). Ned. Tijdschr. Natuurk., 26: 109-17(Apr. 1960). (In Dutch)

The techniques used in the study of elementary particles with nuclear emulsions are described as an introduction to a discussion of some results obtained. The exposure of emulsions to 5.5 Bev/c π^- mesons resulted in the detection of hyperons and decay properties of various mesons. The measurements used for the identification of a π^+ particle were described. The differential cross section for K^+ scattering in nuclear emulsions was determined using both the repulsive nuclear potential and the attractive nuclear potential. (J.S.R.)

29684 A SYMMETRY IN HYPERCHARGE SPACE. V. S. Mathur (Univ. of Delhi). Nuclear Phys., 36: 564-6 (Aug. 1962). (In English)

The principle of minimum electromagnetic interaction is

exploited in a special form to obtain a classification of strongly interacting particles in hypercharge space. Taken together with the Gell-Mann-Nishijima scheme, the new scheme provides interesting information about the spectrum of strongly interacting particles. (auth)

29685 A NOTE ON THE DEUTERON MAGNETIC MOMENT. J. H. Naqvi (Muslim Univ., Aligarh, India). Nuclear Phys., 36: 578-82(Aug. 1962). (In English)

A separable nonlocal potential is used to calculate the ground state properties of the deuteron. Relativistic correction to the deuteron magnetic moment has been taken into account. The value of the deuteron magnetic moment obtained with the above potential is compared with that given by SM and GT potentials. It is found that the nonlocal potential gives better agreement between the calculated and the experimental values than the local potentials. (auth)

29686 CONSEQUENCES OF LEPTONIC ISOSPIN. Elizabeth Johnson (Univ. of Manchester, Eng.). Nuclear Phys., 36: 688-94(Aug. 1962). (In English)

Assuming only three leptons, the leptonic isospin and strangeness of the Nagoya model are derived uniquely from a few fundamental premises. The extension of weak interaction selection rules is discussed and experimental consequences derived. All predictions are consistent with available experimental information. (auth)

29687 DETERMINATION OF π-π CROSS SECTIONS BY THE CHEW-LOW EXTRAPOLATION METHOD. D. Duane Carmony and Remy T. Van de Walle (Univ. of California, Berkeley). Phys. Rev., 127: 959-65(Aug. 1, 1962).

A discussion of the Chew-Low conjecture applied to reactions of the type $\pi + p \rightarrow \pi + p + \pi^0$ is given. The extrapolation technique and the so-called "physical-region-plot method" are discussed. These methods are then applied to a sample of 1684 interactions of the type $\pi^+ + p \rightarrow \pi^+ + p + \pi^0$ and 411 interactions of the type $\pi^- + p \rightarrow \pi^- + p + \pi^0$ at 1.25-Bev/c incident pion momentum. Details are presented of the way in which this sample was obtained and processed. The $\sigma_{\pi^+\pi^0}$ physical-region plots for the π^+ data confirm the existence of the now well-established $T = J = 1$ $\pi-\pi$ resonance at 725 ± 25 Mev. On the other hand, the physical-region plot of the π^- data shows strong deviations from the results expected on the basis of this same resonance. Extrapolation results are presented in detail for seven different $\pi-\pi$ energy regions. The π^- and π^+ data (although very different in the physical region) extrapolate to the same $\pi-\pi$ cross section values for energy regions around the resonance. This fact and the general character of the π^- extrapolations indicate that the π^- physical-region distortions should be attributed to final-state interactions. Although the errors are large, the $\pi-\pi$ cross-section curve obtained by extrapolation on the combined $\pi^+\pi^-$ sample, is in full agreement with the existence of a $\pi-\pi$ P-wave resonance at 725 ± 25 Mev. (auth)

29688 BROKEN SYMMETRIES. Jeffrey Goldstone (Cambridge Univ., Eng.), Abdus Salam, and Steven Weinberg. Phys. Rev., 127: 965-70(Aug. 1, 1962).

Some proofs are presented of Goldstone's conjecture, that if there is continuous symmetry transformation under which the Lagrangian is invariant, then either the vacuum state is also invariant under the transformation, or there must exist spinless particles of zero mass. (auth)

29689 EXPERIMENTAL STUDY OF THE POLARIZATION AND MAGNETIC MOMENT OF THE ANTIPROTON. Janice Button and Bogdan Maglic (Univ. of California, Berkeley). Phys. Rev., 127: 1297-1304(Aug. 15, 1962). (UCRL-10092)

Asymmetries in double scattering of antiprotons of 1.6 Bev/c momentum in the 72-in. hydrogen bubble chamber have been investigated. Analysis of 200 events in which both scatterings occur in the angular region $6.3 \leq \theta_{lab} \leq 23.6°$ yielded a polarization $P = (50^{+8}_{-13})\%$, at an average angle $\theta_{lab} = 10°$. The precession of the spin polarization vector in the magnetic field of the bubble chamber between two scatterings decreases the up-down asymmetries by an amount determined by the magnetic moment of the particle. A method for determination of the magnetic moment of the antiproton, using a three-dimensional likelihood function, is described as applied to the above sample of events. The value of the antiproton magnetic moment was determined to be $\mu_{\bar{p}} = -1.8 \pm 1.2$ nuclear magnetons. (auth)

29690 LOW-ENERGY INTERACTIONS OF K^- MESONS IN HYDROGEN. William E. Humphrey and Ronald R. Ross (Univ. of California, Berkeley). Phys. Rev., 127: 1305-23 (Aug. 15, 1962). (UCRL-10018)

A study has been made of the K-p interactions in a hydrogen bubble chamber. Cross sections have been determined at 25-Mev/c intervals in the range 75 to 275 Mev/c K^- lab momentum. About 90% of the hyperons were produced by K^--p interactions at rest, and these events were used to calculate at-rest production ratios and hyperon lifetimes. The observed hyperon decay rates from this experiment yield the following hyperon mean lifetimes: $\tau_{\Sigma^-} = (1.58 \pm 0.06) \times 10^{-10}$ sec, $\tau_{\Sigma^+} = (0.765 \pm 0.04) \times 10^{-10}$ sec, and $\tau_\Lambda = (2.69 \pm 0.11) \times 10^{-10}$ sec. The observed branching ratios for Σ^+ and Λ decay are $(\Sigma^+ \rightarrow \pi^+ + n)/[(\Sigma^+ \rightarrow \pi^+ + n) + (\Sigma^+ \rightarrow \pi^0 + p)] = 0.490 \pm 0.024$, and $(\Lambda \rightarrow \pi^- + p)/[(\Lambda \rightarrow \pi^- + p) + (\Lambda \rightarrow \pi^0 + n)] = 0.643 \pm 0.016$. The K^--p interactions occurring at rest yield hyperon production rates in the ratio $\Sigma^-: \Sigma^+: \Sigma^0: \Lambda = 0.447 : 0.208 : 0.281 : 0.064$. The in-flight K^--p interactions are dominated by the hyperon production process. Analysis of the elastic-scattering angular distribution shows that the nuclear part of the amplitude has a large imaginary part and a real part consistent with zero. The absorption cross section is nearly geometric for s-wave interactions throughout the observed laboratory momentum range. Angular distributions for all the K^--p interactions are quite consistent with isotropy. An s-wave zero-effective-range analysis of the K^--p interactions has been carried out. Two sets of parameters were found that give acceptable fits to all the data. The χ^2 test gives probability of 48% for solution 1, and 8% for solution 2. The scattering lengths which best fit the data of this experiment are $A_0 = -0.220 + 2.742i$ for the isotopic spin-0 channel and $A_1 = 0.019 + 0.384i$ for the isotopic spin-1 channel. (auth)

29691 MEAN LIFETIME OF THE π^0 MESON. J. Tietge and W. Pueschel (Max-Planck-Institut für Physik und Astrophysik, Munich). Phys. Rev., 127: 1324-7(Aug. 15, 1962).

An estimate of the π^0 mean lifetime has been obtained by a method first attempted by Harris, Orear, and Taylor in 1957. The decay distances of monoenergetic π^0 mesons, produced by the $K_{\pi 2}$ decay at rest ($K^+ \rightarrow \pi^+ + \pi^0$) and decaying via the Dalitz mode ($\pi^0 \rightarrow e^+ + e^- + \gamma$), were measured. In two stacks of nuclear emulsion (Ilford K5), exposed to the 700-Mev/c K^+ beam at the Berkeley Bevatron, 45 events of this type were found. For the π^0 mean lifetime a value of $\tau = (2.3^{+1.1}_{-0.7}) \times 10^{-16}$ sec has been obtained. (auth)

29692 MODEL FOR THE TWO-PION AND THREE-PION RESONANCES. A. N. Mitra (Univ. of Delhi). Phys. Rev., 127: 1342-9(Aug. 15, 1962).

A relativistic model of π-π interaction is proposed from analogy with field theory. The main assumption in the

model is that the interaction kernel is separable in momentum space. A Frazer-Fulco type resonance formula for the isovector 2π resonance is exactly derived on this model and its parameters are determined from the observed 2π resonance at 750 Mev. The 3π problem is then solved with this model of π-π interaction and the exact isoscalar 3π wave function expressed in terms of a single-parameter function which satisfies a one-dimensional integral equation for the cases of "scalar" and "axial vector" forms of the wave function. It is found that it is possible to understand the observed energy (780 Mev) of the 3π resonance, on the above model, only for the case of the axial vector wave function and not for the scalar case. The model thus predicts a vector isoscalar meson at the observed energy. (auth)

29693 ANOMALOUS MAGNETIC MOMENTS OF THE BARYONS IN GLOBAL SYMMETRY MODEL. S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 127: 1350-1(Aug. 15, 1962).

By using the properties of the global symmetry group $SU(2) \times SU(2) \times SU(2)$, the magnetic moments of the baryons have been rigorously derived. The results of earlier authors are shown to follow easily by the present method. (auth)

29694 NUCLEON FORM FACTORS IN THE HELICITY REPRESENTATION. Douglas G. Miller (Harvard Univ., Cambridge, Mass.). Phys. Rev., 127: 1365-8(Aug. 15, 1962).

The cross section for electron-nucleon scattering should be expressed in terms of form factors which are proportional to helicity amplitudes. Then electron-nucleon scattering and pion-nucleon scattering are related even more closely by the π-π interaction in $I = 1$, $J = 1$. In particular the S-wave charge-exchange scattering data complement data on the electric isovector form factor. A consistent picture of the $I = 1$, $J = 1$ π-π interaction requires the narrowness of the 750-Mev resonance. (auth)

29695 EFFECT OF PION-PION INTERACTION ON NUCLEAR FORCES. Robert L. Anderson, Suraj N. Gupta, and John Huschilt (Wayne State Univ., Detroit). Phys. Rev., 237: 1377-9(Aug. 15, 1962).

The effect of pion-pion interaction on the two-nucleon potential is investigated by using the pion-pion coupling, $H = (4\pi f/c\hbar) : U_i U_i U_j U_j :$. It is found that if the coupling constant f is negative, the resulting spin-orbit nuclear force in the nonrelativistic approximation is similar to that produced by the exchange of a neutral meson of mass between 3.3 and 4.1 times the pion mass. A comparison of the theoretical results for the angular dependence of the Wolfenstein coefficient $\bar{C}'$ with those obtained by the phase-shift analysis of the proton-proton scattering at 310 Mev shows reasonable agreement, and gives $f = -0.262$. (auth)

29696 POSSIBILITY OF A $[\sigma(1) - \sigma(2)] \cdot L$ TERM IN HYPERON-NUCLEON INTERACTIONS. B. W. Downs and R. Schrils (Univ. of Colorado, Boulder). Phys. Rev., 127: 1388-90(Aug. 15, 1962).

The possibility of a term proportional to $[\sigma(1) - \sigma(2)] \cdot L$ in hyperon-nucleon interactions is suggested, and an experiment is considered in which the presence of such a term might be detected. (auth)

29697 PION-HYPERON RESONANCES AND POSSIBLE NONCONSERVATION OF ISOTOPIC SPIN. Allen E. Everett (Tufts Univ., Medford, Mass.). Phys. Rev., 127: 1402-4 (Aug. 15, 1962).

A possible explanation of the pion-hyperon resonances is suggested in terms of global symmetry and the possibility that there may be some violation of isotopic spin conservation in strong interactions. In this connection, an alternative spin assignment of $P_{\frac{3}{2}}$ is proposed for the 1520-Mev pion-hyperon resonance. Some possible experimental tests of these ideas are suggested. (auth)

29698 A CLASSICAL THEORY OF BOSONS. H. Schiff (Univ. of Alberta, Edmonton). Proc. Roy. Soc. (London), A, 269: 277-86(Sept. 11, 1962).

A classical (unitary) field theory involving a nonlinear modification of Maxwell's equations, which depends explicitly on the four-potential, is shown to have particle-like solutions which are finite everywhere, in addition to the usual free fields. For a specified charge a discrete mass spectrum is obtained. The neutral and charged systems are independent, the former exhibit asymptotic mutual interactions of the Yukawa type and the latter obey the Lorentz equations in weak external fields. The neutral mass spectrum for a few of the lowest states is obtained numerically and with the aid of a variational procedure and compared with the experimental masses of spin-zero particles. (auth)

29699 ON THE INTERNAL SYMMETRY OF π^0-MESONS. G. S. Mikhailov. Ukrain. Fiz. Zhur., 7: 221 (1962). (In Ukrainian)

It is postulated that a verification of π^0 internal symmetry can be achieved by determining the electric dipole and quadrupole moments. (R.V.J.)

29700 SCATTERING OF 200 Mev NEUTRONS BY PROTONS. Yu. M. Kazarinov and Yu. N. Simonov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 35-9(July 1962). (In Russian)

The total and differential cross sections for scattering of 200-Mev (effective energy) neutrons by protons are measured. The total cross section $\sigma_t = (42.7 \pm 0.9) \times 10^{-27}$ cm^2. The dependence $\sigma(\Phi)$ (cms) is appreciably asymmetric with respect to the angle $\theta = 90$. The π meson-nucleon interaction constant determined by measuring the angular distributions of the scattered particles is $f^2 = 0.08 \pm 0.02$. (auth)

29701 ANNIHILATION OF AN ELECTRON-POSITRON PAIR INTO TWO GRAVITONS. Yu. S. Vladimirov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 89-91 (July 1962). (In Russian)

The effective cross section for annihilation of an electron—positron pair into two transverse quanta of a weak gravitational field (i.e., into two gravitons) is calculated. (auth)

29702 ON THE THEORY OF VECTOR PARTICLES WITH ORIENTED SPINS. Yu. Loskutov and Yu. Popov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 126-30(July 1962). (In Russian)

The theory of vector particles with a non-zero rest mass is considered. The wave function is obtained by taking into account spin states. Elastic scattering for various types of interaction (scalar, vector, tensor, etc.) is investigated. (auth)

29703 ON INELASTIC SCATTERING OF PARTICLES AND THE CHERENKOV RADIATION. M. I. Kaganov (Inst. of Physics and Tech., Academy of Sciences, Ukranian SSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 153-7(July 1962). (In Russian)

The effective cross sections for scattering of neutrons and electrons in condensed media as a result of production or absorption of quasi-bosons (such as phonons, photons, or excitons) are calculated by classical methods. (auth)

29704 STABILITY OF PLANE ELECTRON BEAMS IN BOUNDED SYSTEMS WITH A DECELERATING ELECTRIC FIELD. Yu. N. Dnestrovskii and D. P. Kostomarov (Mos-

cow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 158-65(July 1962). (In Russian)

The stability of stationary charged particle beams in bounded systems with a decelerating electric field is studied. The problem reduces to a Fredholm integral equation of the second kind with a kernel depending on a complex parameter. If the equation does not have proper values in the right-hand half-plane, the stationary solution is stable, and otherwise it is unstable. This criterion is applied to establish the stability of stationary solutions for a number of cases of injection of beams into a system. In particular the stationary solution is stable if the particles are not reflected by the decelerating field, and if all the particles are reflected by the external field and the distribution function of the injected beam is a monotonically decreasing function of the velocity. (auth)

29705 THE $\mu^+\mu^-$- AND e^+e^--PAIR PRODUCTION CROSS SECTIONS FOR NEUTRINOS SCATTERED BY NUCLEI. E. P. Shabalin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret Fiz., 43: 175-80(July 1962). (In Russian)

The pair production cross sections are computed for ~1-Bev neutrinos scattered on nuclei. The magnitudes of these cross sections are estimated in the case of noncoherent scattering. (auth)

29706 ANGULAR CORRELATIONS OF LEPTONS IN K-MESON DECAYS. V. N. Valuev (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 241-5(July 1962). (In Russian)

The e-ν and μ-ν angular correlations in K_{e_3} and K_{μ_3} decays respectively are calculated. It is convenient to compare these correlations with the experimental data if the probability of detection of an electron (or μ meson) depends on its energy. The experimental data are in accordance with the vector theory of the decay interaction and exclude the scalar and tensor variants. (auth)

29707 SOME NEW OPPORTUNITIES FOR STUDYING THE ELECTROMAGNETIC PROPERTIES OF THE ELECTRONS AND μ-MESON. E. D. Zhizhin and V. V. Solov'ev (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 268-76(July 1962). (In Russian)

It is suggested that conversion decays of strongly interacting vector means (ω^0, η^0, and ρ) and the hypothetical σ^0 meson can be used to study the electromagnetic properties of the electron and μ meson at small distances. (auth)

29708 X-RAYS SCATTERING IN GASES, LIQUIDS AND AMORPHOUS SUBSTANCES. P. A. Bezirganyan (Erivan State Univ., Armenian, SSR). Zhur. Tekh. Fiz., 32: 753-8 (June 1962). (In Russian)

The intensity of x rays scattered by gases, liquids, and amorphous bodies was analyzed considering the supplementary phase differences due to parallel waves scattered by the various atoms. The width of the small-angle scattering in the examined case ($\lambda = 1.54$Å) is 8.88°, while in the published literature it is 0.22°. (R.V.J.)

29709 DISTRIBUTION OF THE α-RAY PATH IN SPHERICAL SOURCE. V. G. Gorshkov and O. S. Tsvetkov (Inst. of Physics and Tech., Academy of Sciences, USSR and Radium Inst., Academy of Sciences, USSR). Zhur. Tekh. Fiz., 32: 774-6(June 1962). (In Russian)

α-particle bremsstrahlung in neutron-emitting materials was studied. The distribution of particles emitted from any arbitrary spherical point is analyzed by the length of the path within the source. The neutron yields were determined for light element (Li, Be, B, O, F, S, Mg, Al, Si, and C) mixtures with U and Th in equilibrium with decay products. The most probable grain diameter for Th and U was 2 and 5 μ, respectively, with mean diameters of 2.4 and 6.35 μ. Calculations of the maximum neutron yields for thorium with Be and Al indicate 764 and 20 neutrons per million Th α particles, respectively; experiments showed only 610 and 13. The calculations for U mixtures with Be indicate 710 neutrons, while the experiment shows only 325. The maximum neutron yield for U and Th families were evaluated using the empirical formulas, $Q^{Be}_{max} = 0.728^{E.82}$ and $Q^{Al}_{max} = 1.82 \times 10^{-5}\, E^{6.382}$. Considering α-particle losses in the emitter and the mean α path in a spherical source, the theoretical and experimental data are in agreement within 5%. (R.V.J.)

29710 ISTOCHNIKI α-β-γ I NEITRONNYKH IZLUCHENII. (Alpha, Beta, Gamma and Neutron Radiation Sources). G. M. Fradkin and E. E. Kulish. Moscow, Publishing House of Literature on Nuclear Science, 1961. 88p.

Descriptions are given of various types of α, β, γ and neutron sources used for control and automation of technological processes. Physico-chemical and nuclear properties of materials used in the sources are analyzed. Measuring methods for various technological parameters and data for selecting the most effective nuclear sources are discussed as well as fission processes and radiation reactions with substances. The boom is designed for engineers, technicians, and personnel handling isotopes and radiation sources. (R.V.J.)

Neutron Physics

29711 (HW-71953) SPECTRUM V — INFINITE MEDIUM THERMAL FLUX SPECTRUM PROGRAM. J. E. Schlosser (General Electric. Hanford Atomic Products Operation, Richland, Wash.). Dec. 5, 1961. Contract AT (45-1)-1350. 35p.

Program Spectrum is described for use in calculating the thermal neutron flux spectrum in an infinite homogeneous medium using scattering kernels for monatomic heavy gas with a Maxwellian distribution of velocities. Input parameters necessary for the calculation are the temperature, atomic mass of the moderator, cross sections and atomic densities of moderator and absorbers, energy mesh, and various control numbers. Spectrum can also be used in calculating certain Maxwellian flux distributions. A review of the method used to calculate spectrum, a description of the input preparation, a sample problem, and a listing of the program are included. (J.R.D.)

29712 (K-1520) MODRIC: A ONE DIMENSIONAL NEUTRON DIFFUSION CODE FOR THE IBM-7090. James Replogle (Oak Ridge Gaseous Diffusion Plant, Tenn.). Sept. 6, 1962. Contract W-7405-Eng-26. 34p.

MODRIC is a multigroup one-dimension reactor neutron diffusion code for the IBM-7090. It is written in Fortran language with provision for a maximum of 50 energy groups, 20 regions, and 250 radial points. Neutron scattering by all elements except hydrogen is calculated with the aid of removal cross sections, with a maximum of ten sink groups. For hydrogen scattering the Selengut-Goertzel equation is used. There are options available for criticality search and computing few group constants. (auth)

29713 (TID-12780) VARIATIONAL METHODS IN NEUTRON THERMALIZATION. D. S. Selengut (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1961. Contract [W-31-109-Eng-52]. 9p.

Variational methods for calculating thermal flux distribu-

tion in reactors for design purposes are described. The methods relate the nature and essential features of the scattering kernel to the characteristics of the neutron distributions that have engineering significance. Information is given on variational principles, adjoint functions, and their various interpretations. Typical problems in neutron thermalization are evaluated by this method. The first problem considered is the asymptotic behavior of the neutron distribution, due to a discontinuity in an infinite medium which leads to an exponentially decaying space distribution, or a pulse in a block of material which leads to an analogous eigenvalue problem for the calculation of the decay constant for the time-dependent distribution. The second problem is the calculation of the spectrum of neutrons in an infinite medium generated by a uniform source of fission neutrons, and its use in calculating thermal group constants for simplified models of a reactor. The final problem concerns the calculation of the thermal flux distribution in space and energy in a system with many regions having different compositions and temperatures, which is necessary for accurate reactor design. (N.W.R.)

29714 POLARIZATION OF ELASTICALLY SCATTERED NEUTRONS. Robert James Olness (Duke Univ., Durham, N. C.). Dissertation Abstr., 23: 275(July 1962).

The polarization produced in elastic scattering of 1.509 Mev neutrons from 18 medium and heavy-weight nuclei was measured. The $Li^7(pn)Be^7$ reaction was used as a source of polarized neutrons. Right-left asymmetry in the scattering of the neutrons was measured for scattering angles of 51.5°. The detection system employed pulsed-beam time-of-flight techniques with neutron-gamma ray discrimination. For medium-weight nuclei (A near 100) the observed polarizations vary smoothly with atomic weight; the polarizations of the heavy-weight nuclei (A near 200) show considerable scatter. The observed polarizations are compared with values calculated from a complex potential model (square well) to which a spin-orbit potential was added. The calculated polarizations are discussed with reference to variations in the parameters of the potential. It was found that without introducing arbitrary variations in the parameters of the complex potential it is not possible to obtain simultaneous agreement between experimental and calculated values for both the medium and heavy-weight nuclei. However, reasonable agreement was obtained by employing slightly different parameters for the two regions of atomic weight. (auth)

29715 ENERGY-DEPENDENT MULTIPLE SCATTERING OF NEUTRONS IN THIN PLATES. R. O. Lane and W. F. Miller (Argonne National Lab., Ill.). Nuclear Instr. & Methods, 16: 1-16(June 1962). (In English)

A Monte Carlo calculation is described that yields relative fluxes for first-, second-, and third-order elastic scattering of neutrons in thin plates. The method specifically includes the effects from energy loss by the neutron following elastic scattering, together with the corresponding energy dependence of the cross sections for subsequent collisions. Illustrative examples of some typical cases are presented. (auth)

29716 SYSTEMATIC STUDY OF SOME COLD-NEUTRON SOURCES. W. Van Dingenen (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Nuclear Instr. & Methods, 16: 116-28(June 1962). (In English)

Systematic measurements of apparent neutron temperatures and of energy spectra are made for neutrons slowed down by small amounts of hydrogeneous moderating materials, cooled to liquid nitrogen and liquid hydrogen temperatures. Some qualitative conclusions are drawn about the moderation phenomena at very low temperatures. (auth)

29717 NEUTRON-SPECTROMETRY UNITS. Carl A. Anderson and Theos J. Thompson (Massachusetts Inst. of Tech., Cambridge). Nucleonics, 20: No. 8, 157(Aug. 1962).

A nomogram is presented which provides rapid and accurate conversion between neutron energy, velocity, wavelength, and time-of-flight. The energy range covered is 5×10^{-8} to 10^{8} ev. (D.L.C.)

29718 INFLUENCE OF INTERFERENCE SCATTERING ON THE SCATTERING OF SLOW NEUTRONS BY GASEOUS METHANE. George W. Griffing (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 127: 1179-81(Aug. 15, 1962).

Recent computations on the partial differential cross section for the scattering of slow neutrons from gaseous methane have been extended to momentum transfers large enough to investigate the full range of the available experimental results. It is found that the interference scattering from carbon-proton and proton-proton pairs has an effect on the scattering that can be observed. The experimental results appear to show such an effect and are in agreement with the results of the computations. (auth)

29719 EFFECT OF SPIN-PHONON INTERACTION ON THE ENERGY DISTRIBUTION OF SCATTERED NEUTRONS IN A PARAMAGNET. B. M. Khabibullin (Kazan Inst. of Physics and Tech., Academy of Sciences, USSR). Soviet Phys.-Solid State, 4: 428-32(Sept. 1962).

An equation is obtained for the differential cross section for neutron scattering by the Stark levels of paramagnetic atoms in the crystalline field, taking into account the spin-phonon interaction. The shift and broadening of the curve that describes the scattering at T = 20°K, arising from crystal defects, is of the order of 10 cm^{-1}. (auth)

29720 EFFECT OF SPIN-SPIN AND SPIN-PHONON INTERACTIONS IN ANTIFERROMAGNETS ON THE ENERGY DISTRIBUTION OF SCATTERED NEUTRONS. V. N. Kashcheev (Riga Inst. of Physics, Academy of Sciences, Latvian SSR). Soviet Phys.-Solid State, 4: 556-65(Sept. 1962).

The effect of spin-spin and spin-phonon interactions on the broadening of one-magnon neutron scattering peaks for a uniaxial antiferromagnet in a weak external field is examined. The broadening and peak shift of the one-magnon scattering peak caused by these interactions are determined as a function of the magnon wave vector, external field, and temperature. The low-temperature corrections to the temperature-dependent part of the magnetization arising from these interactions are calculated. (auth)

29721 STORAGE OF COLD NEUTRONS. A. G. Doroshkevich. Zhur. Eksptl'. i Teoret Fiz., 43: 79-80 (July 1962). (In Russian)

The possibility of preserving cold neutrons in a 1-m^3 cubic cavity with beryllium walls is considered. The lifetimes of the neutrons with respect to capture and heating are estimated. The probability of heating up of the neutrons by surface oscillations of the walls is also estimated. (auth)

29722 NEITRONNAYA FIZIKA. (Neutron Physics). P. A. Krupchitskogo, ed. Moscow, Gosatomizdat, 1961. 371p.

Forty papers on neutron physics were collected. Separate abstracts were prepared for 24 papers. Sixteen were previously abstracted for NSA. (M.C.G.)

29723 SOLUTION OF VICK'S PROBLEM AND CORRESPONDING PARTIAL PROBABILITIES OF NEUTRON

TRANSPORT. I. G. Dyad'kin. p.3-13 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

In an earlier work, a solution to the equation of neutron transfer was obtained for an unbounded medium through the summation of partial probabilities. Successive proportional probabilities of neutron transfer from one point in phase space to another after any n collisions were presented as a 3-n-fold integral. In the case of a constant mean free path, the partial probabilities could be obtained as a two-fold integral of Fourier-Laplace from some matrix element. The partial probabilities obtained by such an approach were summarized. Also, the solution of Vick's problem was obtained as a double Fourier-Laplace integral from the elements of the fractional functions of the matrix. In this work, expressions of these matrix elements are presented as elementary functions. These solutions of Vick's problem submit to calculation even without the use of computing machines. For purposes of calculation, one can place a physically reasonable upper bound on the number of terms of the expansion that need be retained. From the presentation, it is clear that three terms are fully adequate. (TTT)

29724 THE THEORY OF CONJUGATE FUNCTIONS. G. I. Marchuk and V. V. Orlov. p.30-45 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The physical meaning of a conjugate function as applied to reactor theory is taken to be the neutron worth. A function having the idea of a statistical weight, or of worth, can be introduced for any physical quantity which is a linear functional of a flow of radiation (heat, electromagnetic waves, neutrons, etc). The conjugate function and the concept of worth are related mathematically. The introduction of perturbation theory for linear functionals follows readily. A conjugate equation can be obtained by assuming conservation of neutron worth, just as a kinetic equation for neutron flow can be derived from the conservation of the number of particles. Various perturbations lead to a change in the reaction cross-section. Thus, changes occur in the operator of the principal kinetic equation, and of the conjugate equation. The resulting, perturbation theory equations are useful in finding a simplified model for a complex system. The worth of a neutron in a reactor can be expressed as a function of the position, energy and flight angle of the neutron. (TTT)

29725 THERMALIZATION OF NEUTRONS IN HETEROGENEOUS REACTOR WITH THERMAL NEUTRON. P. P. Blagovolin. p.56-65 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

A monatomic heavy-gas model was considered in diffusion theory approximations. Consideration was limited to the case of small absorption, i.e., when the mean temperature of the neutrons in the active zone is larger than the temperature of the moderator by not more than 10 to 15%. It is supposed that the solution of the one-velocity problem takes into account the fundamental effects of heterogeneity, and that the influence of the variation of spectrum with position can be treated as a perturbation. The magnitude of this perturbation was estimated with the aid of analytical solutions. The correction, or perturbation, calculated by the formulas given compare favorably with the corrections obtained from calculations of the integral equation. (TTT)

29726 SOLVING THE EQUATION FOR THE MODERATION OF NEUTRONS BY MEANS OF CONJUGATE MOMENTS. V. F. Turchin. p.66-73 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

Neutron moderation in a pure material (but not in hydrogen) can be described by the equation: $\sigma_t(u)\phi(u) = \int_u^{u_0} \sigma_s(u_0) \times f(u_0 \rightarrow u)\ \phi\ (u_0)\ du_0$, where $\sigma_s(u)$ and $\sigma_t(u)$ are the scattering cross-section and the total cross-section on slowing-down of a neutron from u_0 to u. The term $f(u_0 \rightarrow u)du$ is the probability that a neutron having a velocity u_0 will have a velocity u in the interval du after scattering. The function for the scattering density $\Psi(u) = \sigma_s(u)\,\phi(u)$ is introduced. Then, the function $\Psi(u_0)$ can be represented in the form of a second-order parabola $[A_i + B_i\,(u_0 - u_i) + C_i\,(u_0 - u_i)^2]$. A recurrent relationship is then derived by which it is possible to obtain an approximate solution of the moderation equation by a finite-difference method. Knowledge of only the first three conjugate moments of the function $f(u_0 \rightarrow u)$ as a function of the final velocity u is required to use this equation. The solutions for the slowing-down length are more stable than those obtained by replacing the function $\phi(u_0)$ by a Taylor's series near the point $u_0 = u$. (TTT)

29727 NEUTRON SCATTERING ON CRYSTALS IN INCOHERENT APPROXIMATION. V. F. Turchin. p.74-91 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The incoherent approximation neglects the interference of neutron waves incident on a crystal, except that the coherent scattering contains an interference effect that appears as a perturbation. This can be estimated. At small primary neutron energies, the double differential cross section, in energy and solid angle, has a very important difference in coherent and incoherent scattering: the incoherent cross sections are continuous, the coherent contains a delta-function. With integration over angle, the delta function vanishes and the remaining differential cross sections in energy, for coherent and incoherent scattering, do not differ strongly. With integration over energy the final neutron energy is obtained and the influence of interference on such integral parameters as total inelastic scattering cross section and energy transfer moments are further diminished. Integration over angle was carried out to obtain differential cross sections, in energy; and further integration over energy was done to obtain energy transfer. Elemental crystals such as beryllium or graphite are treated. (TTT)

29728 ON THE THEORY OF NEUTRON THERMALIZATION IN HEAVY CRYSTALLINE MODERATORS. A. V. Stepanov. p.92-9 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

An extension was made of a general method of analysis of neutron thermalization and diffusion for heavy materials. According to the general method, the description of neutron thermalization requires information about the dynamic characteristics of the moderator, information contained in the group theory coefficients. It is shown that with some assumptions about the spectrum of proper oscillation frequencies of the moderator lattice, expressions can be obtained for the group theory coefficients. These expressions are given in the form of a rapidly converging series. The dependence of the group theory coefficients on the form of the lattice vibrational spectrum of the moderator is also treated. (TTT)

29729 CROSS-SECTION FOR ELASTIC SCATTERING OF SLOW NEUTRONS BY PROTONS BOUND IN BENZENE MOLECULES. M. A. Kovner and G. I. Kolerov. p.100-4 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

A calculation was made of the ratio of the mean elastic scattering cross section (averaged over all scattering cycles and over a Boltzman distribution of molecular velocities) to the cross section of free protons, for protons bound in the benzene molecule. The calculation utilized the theory of Messiah (Phys. Rev., 84: 204(1951)) and Sachs and Teller (Phys. Rev., 60: 18(1941)) and the vibrational analysis and frequency assignment for benzene previously

given by Kolerov. Results are given for the neutron energy in the range 0.005 to 0.050 ev; the calculated ratios are monatomic between 3.783 and 2.317. (TTT)

29730 THE RESONANCE ABSORPTION OF NEUTRONS BY A SLUG. V. V. Orlov, T. V. Golashvili, and A. I. Baskin. p.116-24 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The problem of the absorption of neutrons by a slug surrounded by a moderator is significantly simplified, if it is assumed that the average loss of energy during a collision with the nuclei of the slug is greater than the resonance width. A general formula for the resonance interval of the slug can be obtained with this assumption. Scattering and slowing-down of neutrons in the slug, and also the possibility of passage of a neutron through the slug are taken into account. An expression is derived for the effective resonance interval which characterizes the absorption of neutrons in the slug. The expression can be broken down into two parts, where $J_{eff} = J_{eff}^{vol.} + J_{eff}^{surf.}$. Here $J_{eff}^{vol.}$ is the volume part of the effective resonance interval, and $J_{eff}^{surf.}$ is the surface part of the effective resonance interval. For "small" slugs a formula is obtained, in which neutron scattering in the slug can be neglected. For "large" slugs the Wigner formula is obtained, where $J_{eff} = a + (b/(\bar{l}))$. Here a is the volume absorption of neutrons, b is the surface absorption of neutrons, and $(\bar{l})$ is the mean free path in the slug. The value of J_{eff} is given for a Breit-Wigner type of resonance. An expression is derived for the temperature dependence for the surface adsorption of neutrons. (TTT).

29731 MULTIGROUP METHOD FOR CALCULATING THE SPACE-ENERGY DISTRIBUTION OF THERMAL NEUTRON FLUX AND APPLICATION OF THEORY OF PERTURBATION. G. I. Marchuk and V. V. Smelov. p.143-60 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The space-energy distribution of neutrons which is approximately described in a multigroup system of diffusion equations was considered. The group constants were obtained by the basic application of the mathematical apparatus of conjugate equations. The multigroup method takes into account the thermal motion of the moderator nuclei, and the crystalline and molecular bonds. The multigroup system was determined by the method of matrix factorization. In the frame of the multigroup presentation, a method is given for obtaining formulas of established theory. Examples are presented. (TTT)

29732 CALCULATIONS OF THERMAL COEFFICIENT CONSIDERING NEUTRON THERMALIZATION. G. I. Marchuk and V. V. Smelov. p.161-8 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

Two methods are suggested for resolving the problem of evaluating non-diffusivity in determining thermal neutron space-energy distributions. One method employs approximations of the spherical harmonics method that are of higher range than the diffusion; the other is based on developing effective boundary conditions on the surface of a uranium block in order to refine the theory of diffusion. A plane parallel layer and a moderator layer were analyzed. (R.V.J.)

29733 DIFFUSION AND ATTENUATION LENGTHS OF NEUTRONS IN DIPHENYL AND MONOISOPROPYLDIPHENYL. L. N. Yrova, A. A. Polyakov, S. B. Stepanov, and V. B. Troyanskii. p.192-7 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The neutron diffusion lengths in diphenyl at 35, 85, and 130°C and in monoisopropyldiphenyl at 20°C were measured using $Sb^{122} + Be^{9}$ neutrons. The axial distribution of thermal neutron density was measured with 100 mg/cm^2 indium detectors. The hydrogen transport cross sections σ_{tr}^{H} were calculated using the obtained magnitudes for the diffusion length. The magnitude corresponds to the value for Maxwell neutron distribution. The data showed that the diffusion constants of organic hydrogen-containing compounds are similar to those for water. The diffusion length for noncrystalline hydrogen-containing substances may be calculated by using the obtained mean transport cross section for H and assuming it is a function of energy according to the 1/v law. The age of U^{235} fission neutrons was measured in solid diphenyl. The distribution of resonance neutrons in diphenyl surrounded by a graphite reflector (thermal column) corresponds to resonance neutron distribution in infinite diphenyl. The age of fission neutrons in diphenyl is $\tau(1.4 \text{ ev}) = 54.2 \pm 2.5$ cm^2 at 35°C. The spectrum of Po-Be neutrons was also measured using previously developed formulas for diphenyl of density 1 g/cm^3. (R.V.J.)

29734 EFFECTIVE CROSS-SECTIONS AND FISSION ANISOTROPY OF Np^{237} AND Th^{230}. G. A. Otroshchenko and V. A. Shigin. p.211-16 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

Neutrons produced by the reaction of protons from an electrostatic generator with tritium were used to measure effective fission cross sections and anisotropies in the neutron energy range up to 1.5 Mev for Np^{237} and up to 1.2 Mev for Th^{230}. For Np^{237}, the effective cross section increased in sigmoid fashion from ~20 millibarns at 12 kev to 1.45 barns at 1.5 Mev; the anisotropy (ratio of cross section for fission-fragment direction at 0° to neutron beam to cross section for fission fragment at 90° to neutron beam) was unity at low energies and rose slowly to ~1.2 at 1.5 Mev. For Th^{230} the effective cross section (measured on a relative scale only) showed a small local maximum at ~770 kev and a rapid monatomic increase to much higher values between ~870 and 1200 kev. The anisotropy of Th^{230} decreased from ~2 at ~670 kev to ~1.1 at 1 Mev, then rose to ~1.4 at 1.2 Mev. (TTT)

29735 AVERAGE NUMBER OF PROMPT FISSION NEUTRONS OF U^{238} AND Th^{232}. B. D. Kuz'minov. p.241-5 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

Although the average number of prompt fission neutrons $\bar{\nu}$ plays an important role in reactor design, satisfactory data are available only for U^{233}, U^{235}, and Pu^{239}; the corresponding values for U^{238} and Th^{232} must be obtained for designing reactors in which the fission of these isotopes is a high portion of the total number of fissioning atoms. These values were measured by means of fission chambers with thick targets placed in the path of neutron beams obtained from the $D(d,n)He^3$ and $T(d,n)He^4$ reactions. The function of $\bar{\nu}$ versus the neutron energy was plotted; for continuous neutron spectra the average effective neutron energy was calculated as $\bar{E}_n = 3.1$ Mev for U^{238} and 3.5 Mev for Th^{232}. The slopes of these curves were found to be 0.139 ± 0.008 Mev^{-1} for U^{238} and 0.15 ± 0.01 Mev^{-1} for Th^{232}, agreeing well with the data reported by Bondarenko et al. (Transactions of the Second Conference for the Peaceful Applications of Atomic Energy, Geneva, 1958). (TTT)

29736 INTERACTION OF 14.1-Mev NEUTRONS WITH LITHIUM-6 AND LITHIUM-7. K. M. Mikhailina, A. A. Nomofilov, T. A. Romanova, V. A. Sviridov, F. A. Tikhomirov, and K. D. Tolstov. p.249-57 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The total reaction cross section of the interaction of 14.1-Mev neutrons with Li^6 and Li^7 nuclei was determined by 2 methods: exposing a photographic plate containing

these isotopes to a neutron beam, and determination of the angular distribution of the particles escaping under a small angle. The amount of Li in the emulsion was found to be 2.3×10^{19} cm^{-2}. The 14.1-Mev neutrons were obtained from the t(d,n)He^4 reaction; the integral neutron dose was about 10^8 cm^{-2}. The cross sections of the Li^6(n,t)α and Li^7(n,t)He^5 reactions were found to be similar to those reported by G. M. Frye (Phys. Rev., 93: 1086(1954)) and F. L. Ribe (Phys. Rev., 87: 205(1952)). Outside of photographic measurements, no reliable data are available concerning the other reactions; the cross sections of the Li^6(n,d)He^5 and Li^6(n,d)He^{5*} reactions do not agree with those given in Frye's paper; however, the possibilities of the inelastic scattering of neutrons on Li and the (n,2n) reaction were considered. The total cross sections of the Li^6 reactions which accompany the escape of neutrons was found to be 179 ± 20 millibarns. (TTT)

29737 TOTAL CROSS SECTIONS OF U^{235} AND Th^{232} FOR NEUTRONS WITH ENERGIES RANGING FROM 2 TO 8 Mev. V. Ya. Averchenkov and A. I. Veretennikov. p.258-62 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The total cross section measurements were carried out by the time-of-flight method with a static Po–Be source, using a multichannel analyzer. The ratio of the effect to accidental coincidences was ~7 for U^{235} in the 5 to 6 Mev range and ~2 for the 2 to 8 Mev range; this ratio was somewhat more unfavorable for Th^{232} in view of its natural γ background. Results of the measurements for U^{235} confirmed the data published in Hughes and Schwartz's collection, Nuclear Cross Section, BNL 1958. The Th^{232} cross section was determined for the 3 to 7 Mev range with a precision of ~7%, worsening to 13% near the limits of the range. The corrections for inelastic scattering were below 1%. (TTT)

29738 THE SPACIAL DISTRIBUTION OF NEUTRONS IN MIXTURES OF BORON CARBIDE CONTAINING IRON AND LEAD. D. L. Broder, A. P. Kondrashev, and A. A. Kutuzov. p.263-77 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The removal or extraction cross section of an element is the effective cross section equivalent to the absorption cross section for fast neutrons. It consists of that part of the elastic cross section due to neutron scattering at a large angle, and the cross section of all processes leading to neutron absorption. Inelastic scattering contributes significantly to the removal of neutrons from a beam, because this type of scattering is more isotropic than elastic scattering, and leads to a large loss in neutron energy. The removal cross sections were determined for Fe and Pb in the presence of boron carbide for 4 and 14.9 Mev neutrons. The neutron beam was sent through a vessel provided with ten compartments each of which was 1000 mm in diameter and 100 mm long. Solid boron carbide with a dry density of 1.1 g/cm^3 was placed in each compartment. Compartments 2 and 3 could be replaced with a slug of iron or lead. Provisions were made to monitor the neutron energy with a Th^{232} fission chamber, a U^{235} fission chamber, or with threshold detectors of phosphorus and aluminum. The induced activity was determined by beta counting. The removal cross section was calculated from the formula: $\sigma_{rem.} = \ln (I_1/I_2)/T$. Here I_1 and I_2 are the count rates of the detector multiplied by the square of the distance and normalized to unity at zero thickness for boron carbide and for the mixture respectively. T is the thickness of the test sample of the element. The data show that in boron carbide the spectrum of fast neutrons with E > 1.5 Mev is in equilibrium at distances from the slug on the order of $r_0 = 4.2\lambda$ for 4 Mev neutrons and of $r_0 = 3.2\lambda$ for 14.9 Mev neutrons (λ is the mean free path of the neutrons in boron carbide). The removal cross sections of iron and lead are close to the values of the removal cross sections of these materials as measured in water. (TTT)

29739 REMOVAL CROSS-SECTIONS FOR FAST NEUTRONS HAVING ENERGIES OF 3 AND 15 Mev. V. I. Kukhtevich, B. I. Sinitsyn, and S. F. Degtyarev. p.278-82 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The removal cross sections σ_{rem} for 3 and 15 Mev neutrons are given for Be, B, C, O, Al, S, Ti, Fe, Ni, Cu, Zn, Zr, W, Pb, Bi, BeO, B_4C, C_6H_6, and Pb_3O_4. The 3 and 15 Mev neutrons were obtained from the reactions D(d,n)He^3 and T(d,n)He^4. In addition to the microscopic cross section σ_{rem} and the mass cross section Σ_{rem}/ρ, measurement results are also presented for the total cross section σ_t, the total elastic scattering cross section σ_{el}, the average cosine $\bar{\mu}$, the total transport cross section σ_{tr}, and the minimal distance R in cm, from which the thermal neutron count characterizes the neutron attenuation. The difference in the removal cross sections for 3 and 15 Mev neutrons decreases from an 80% difference in the region of the light elements to a 10 to 15% difference in the region of the heavy elements. The removal cross section σ_{rem} and the transport cross section σ_{tr} differ by 10%. The removal cross section equals about $\frac{2}{3}$ the total cross section with an accuracy of 7% for 15 Mev neutrons with comparable elements. For 3 Mev neutrons, $\sigma_{rem} \approx 0.63\ \sigma_t$ with an accuracy of only 17%. In this case a more accurate estimate is obtained by using σ_{tr} in place of σ_t. The results show that the removal cross section does depend on the neutron energy, at least in the 3 to 15 Mev region, and especially for the light elements. (TTT)

29740 INELASTIC SCATTERING OF FISSION NEUTRONS AND OF 0.9 Mev NEUTRONS IN U^{235} AND Pu^{239}. V. N. Andreev. p.287-93 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

A sphere with a diameter of 5 cm and a wall thickness of 1 cm, and a thinner spherical shell with a diameter of 4.3 cm and a wall thickness of 1.5 mm were made up from 90% enriched U^{235} and from Pu^{239}. The sphere and the thinner spherical shell were alternately exposed to a broad beam of thermal neutrons from the thermal column of a reactor. The fission neutrons generated on the external surface of the samples were counted by a fission chamber placed in the center of the U^{235} and Pu^{239} samples. A U^{238} or Th^{232} fission chamber was used to count the 1.4 to 1.6 Mev neutrons, and a Np^{237} threshold fission chamber was used to count the 0.6 Mev (or higher) neutrons. A two-group calculation of the neutron kinetics in the sphere and in the shell was carried out. The inelastic scattering cross sections for fission neutrons were found to be 0.63, 1.40, and 1.79 barns for 90% U^{235} with threshold detectors of Np^{237}, U^{238}, and Th^{232} respectively. These values were 0.90, 1.07, and 1.37 barns for Pu^{239} with threshold detectors of Np^{237}, U^{238}, and Th^{232} respectively. With 0.9 to 1.0 Mev photoneutrons from a Na-Be source, the inelastic scattering cross sections were found to be 1.1 barns in U^{235} and 0.9 barn in Pu^{239}. (TTT)

29741 INELASTIC SCATTERING CROSS-SECTIONS OF 2.5 Mev NEUTRONS. G. N. Lovchikova and O. A. Sal'nikov. p.294-7 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The inelastic scattering cross sections of 2.5 Mev neutrons in Mo, Ba, Sr, Na, and K were measured by placing a Np^{237} or U^{238} threshold detector within a hollow sphere

of the scattering material (having an external diameter of 90 mm and an internal diameter of 30 mm). A D(d,n)He^3 reaction was used to generate the 2.5 Mev neutrons. The transmission T, which is the ratio of the number of neutron counts with the scattering target in place to the number of neutron counts with the scattering target removed, was determined experimentally. After correcting for the thickness of the scattering material and the geometry of the experiment, the inelastic scattering cross sections were found to be 0.0 (not detectable) for sodium, 0.0 (not detectable) for potassium, 0.32 ± 0.15 for strontium, 0.46 ± 0.03 for molybdenum, and 0.77 ± 0.10 barn for barium with Np^{237} as the threshold detector. These values were 0.34 for Na, 0.0 (not detectable) for K, 1.10 for Sr, 1.36 for Mo, and 1.47 barns for Ba with U^{238} as the threshold detector. (TTT)

29742 INELASTIC SCATTERING OF 3.2 TO 4.5 Mev NEUTRONS BY BERYLLIUM. Yu. G. Zubov, N. S. Lebedeva, and V. M. Morozov. p.298-305 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

Coincidence neutron counting was used to investigate the cross section for the reaction Be^9(n,2n)Be^8 as a function of the energy of the incident neutrons. The source of neutrons was a gaseous deuterium target irradiated with a beam of deuterons from an electrostatic accelerator. A collimated beam of neutrons struck a beryllium target. The scattered and emitted neutrons were slowed down to thermal energies by a Plexiglass moderator, and were counted by three concentric arrangements of 9, 18, and 27 proportional gaseous BF_3 counters containing 80% enriched B^{10}. The groups of counters were separated from each other on the order of a diffusion length for the thermal neutrons in the moderator being used. The resolution time of the coincidence arrangement was 200 microseconds, and was dictated by the lifetime of the thermal neutrons in the moderator of about 100 microseconds. The transmission of the beryllium sample was measured experimentally. Corrections were made for the elastic scattering of neutrons and for the (n,α) reaction on Be. The cross sections for the (n,2n) reaction on beryllium for neutrons having energies of 3.2, 3.7, 4.1, and 4.5 Mev were found to be 0.8, 0.73, 0.53, and 0.45 barn respectively. The effective threshold for the (n,2n) reaction occurs at 2.6 to 3.2 Mev neutron energies. No reaction is detectable with 2.6 Mev neutrons. This (n,2n) reaction on beryllium is in reality a cascade process (n,n′,n″). First, an excited state of Be^9 is formed with an excitation energy of 2.43 Mev, and the excited Be^9 decays with emission of a neutron to Be^8. (TTT)

29743 ANGULAR DISTRIBUTION OF 3.1 Mev NEUTRONS ELASTICALLY SCATTERED BY Al, Si, K, Ca AND Th. V. I. Popov. p.306-9 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

A target of deuterium as heavy ice was bombarded with 250 kev deuterons to produce 3.1 Mev neutrons by a D(d,n)He^3 reaction. The angular distribution of the elastically scattered neutrons was measured by a hydrogen ionization chamber in a cylindrical arrangement about the target. On the basis of an optical model of the nucleus, the elastic scattering of neutrons by a compound nucleus can be followed directly by comparing the angular distributions of elastically scattered neutrons by elements which are close to each other in atomic weight, but which differ from each other in the magnitude of the elastic scattering cross sections. A comparison of the thorium data with analogous data shows that elastic scattering of neutrons does not occur through a compound nucleus in the case of thorium and mercury, but does occur in the case of lead. The magic nucleus Ca^{40} shows considerable backscattering of neutrons due to the fact that elastic scattering through a compound nucleus is relatively high at large scattering angles. The differential cross section for potassium is 40% less than that of Ca^{40} at large scattering angles. The effect of separate resonances is more apparent for silicon than it is for aluminum. (TTT)

29744 FAST NEUTRON CAPTURE CROSS-SECTIONS FOR TUNGSTEN AND MOLYBDENUM. Yu. Ya. Stavisskii and A. V. Shapar'. p.310-11 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

The capture cross section as a function of energy in the interval of 0.05 to 1.00 Mev neutron energies was measured for the natural isotopic mixture of tungsten and molybdenum. The neutrons were obtained by a T(p,n)He^3 reaction. A Van de Graaff generator was used as a proton accelerator. A scintillation counter with a CaF_2 crystal was used to count the instantaneous capture γ rays in the presence of a high neutron flux. The radiation capture cross sections were compared with the fission cross section of U^{235} as a function of neutron energy, and also with the capture cross section for I^{127}. The capture cross sections for 0.2 Mev neutrons were found to be 59 ± 10 millibarns for molybdenum, and 122 ± 21 millibarns for tungsten. The results are compared graphically with the results of other data in the literature. (TTT)

29745 A NUMERICAL METHOD OF SOLVING THE SCHROEDINGER EQUATION HAVING A SMOOTHLY VARYING POTENTIAL. S. M. Ermakov, V. E. Kolesov, and G. I. Marchuk. p.314-23 of "Neitronnaya Fizika." Moscow, Gosatomizdat, 1961.

A method is described in which the energy levels within a nucleus are calculated for two assumed sets of parameters. Cross sections which are expressed in terms of a log derivative in the region where the absolute value of the potential is small can also be computed. No limitations are placed on the potential, but a Woods-Saxon form of the potential was used in calculating the neutronic energy levels in the nucleus. The method of calculation can easily be set on a digital computer in the form of a set of linear algebraic equations. The elastic scattering cross section σ_{el} (without the formation of a compound nucleus), the capture cross section σ_c, and the total cross section σ_t were calculated for nickel and uranium, and were compared with experimental values taken from Hughes. The theoretical values of the total cross section are in good agreement with the experimental values from a neutron energy of 2 to 3 Mev and higher. The existence of a resonance structure for nickel at lower neutron energies impairs the agreement between the theoretical and experimental values. There is good agreement with the experimental values for uranium over a wide region of neutron energies from 0.1 to 15 Mev. The theoretical curve for uranium is below the experimental curve for the angular distributions of elastic scattering for 1 Mev neutrons. The agreement with the experimental values for uranium can be improved by taking into account the elastic scattering by means of a compound nucleus. (TTT)

Nuclear Properties and Reactions

29746 (AERE-R-4131) THE INSTITUTE OF PHYSICS AND THE PHYSICAL SOCIETY CONFERENCE ON LOW ENERGY NUCLEAR PHYSICS, HARWELL, SEPTEMBER 1962. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1962. 33p.

Seventy-six abstracts are presented of papers to be presented at the conference. (N.W.R.)

29747 (AFOSR-971) ANGULAR DISTRIBUTION OF γ RADIATION FOLLOWING DIRECT NUCLEAR REACTION. M. Nomoto (Florida State Univ., Tallahassee). [nd]. 7p.

Gamma angular distributions following the reaction $C^{12}(p,p'\gamma\ 4.43\ Mev)C^{12}$ were recently measured for incident proton energies at 5 to 11.5 Mev. To analyze these data at the higher energies, calculations of γ angular distributions following an assumed direct reaction were made both for the case of single particle excitation and collective excitation. Calculations were made for E = 6.69, 8.46, 8.71, and 9.72 Mev. (J.R.D.)

29748 (AFOSR-TN-3065) ELECTRON SCATTERING AND EFFECTIVE CHARGE. Technical Note No. 68. J. D. Walecka and R. S. Willey (Stanford Univ., Calif. Inst. of Theoretical Physics). July 1962. Contract AF 49(638)-388. 21p.

The possibility of studying single-particle nuclear transition charge densities with inelastic electron scattering is discussed and it is pointed out that such experiments lead to valuable information about the nature of the "effective charge." Calculations of cross sections were carried out for various models of the effective charge and it is shown that the momentum transfer dependence of the cross section distinguishes between them. (auth)

29749 (AFOSR-TN-3066) EXCITATION OF INDIVIDUAL-PARTICLE STATES OF NUCLEI BY INELASTIC ELECTRON SCATTERING. Technical Note No. 66. Raymond S. Willey (Stanford Univ., Calif. Inst. of Theoretical Physics). June 1962. Contract AF 49(638)-388. 63p.

Formulas are given for the computation of cross sections for excitation of shell model states in light nuclei by inelastically scattered electrons. The contributions from the transverse electric and magnetic interactions are calculated in detail. The determination of radiative lifetimes by extrapolation of electron scattering data is discussed and found to be model-dependent. Particular calculations are carried out for Li^7 and O^{18}. The Li^7 calculation provides an example in which the contributions from the transverse interactions are of the same order of magnitude as the contribution from the Coulomb interaction, even at small momentum transfer. In the case of O^{18}, electron scattering experiments may distinguish collective excited states from individual-particle excited states. (auth)

29750 (ANL-6589) THE ELECTRIC-DIPOLE GAMMA-RAY STRENGTH FUNCTION FOR HEAVY EVEN-EVEN NUCLEI. Raymond T. Carpenter (Argonne National Lab., Ill.). Aug. 1962. Contract W-31-109-Eng-38. 130p.

Gamma spectra following neutron capture were observed in a large number of neutron resonances in twelve even-even compound nuclei between Nd^{144} and Hg^{202}. Absolute values of the transition probabilities of the highest energy E1 gamma transitions were obtained for most resonances observed and averaged over all resonances considered in a given nuclide. The resonance-average values so obtained yielded transition probabilities which are characteristic of the particular transitions considered with relatively good precision. This is in contrast to the values obtained from similar studies of thermal-neutron-capture gamma spectra which are beset with inherent and rather severe uncertainties. The dependence of the experimental values on the energy of the radiated gamma ray and the mass of the radiating nucleus is consistent with both the semi-classical prediction $A^{\frac{5}{3}} E_\gamma^3$ and the recent prediction of the giant-dipole-resonance approximation, $A^{\frac{5}{3}} E_\gamma^4$. Further, if either of these mass-energy factors is removed, the resulting reduced widths are observed to be closely proportional to the spacing of neutron resonances, as predicted by both theories. It thus becomes significant to define an E1 gamma strength function as the resonance-average value of the partial width divided by the average spacing between neutron resonances and the appropriate energy factor and to study its dependence on the atomic mass of the radiating nucleus. The E1 gamma strength functions were constructed according to both proposed energy dependences and found to follow the predicted mass dependence, although there are suggestions of peaks near the closed neutron shells. The absolute value of the strength function constructed according to the giant-dipole-resonance approximation is in reasonable agreement with the theoretical prediction, but there is violent disagreement in the other case. The implications of this and other aspects of the results are discussed. Since the techniques used to analyze the data are for the most part new, they are dealt with in considerable detail. The pertinent theory and the techniques used to obtain the data are also discussed. (auth)

29751 (BNL-5013) OPEN QUESTIONS IN NUCLEAR STRUCTURE—SOME EXPERIMENTAL APPROACHES. D. H. Wilkinson (Brookhaven National Lab., Upton, N. Y.) [1960]. Contract [AT(30-2)-Gen-16]. 160p.

Experimental attempts to tackle the nuclear structure problem are reviewed. Structure problems in light nuclei, the optical model, the nuclear surface, relationships between nuclear states, cluster models of the nucleus, momentum distribution in the nucleus, three body faces, nuclear molecules, and elementary particles in nuclear structure studies are discussed. One hundred and twenty-two references are included. (M.C.G.)

29752 (EFINS-62-26) THE SINGLE PARTICLE NILSSON MODEL FOR ODD-A NUCLEI IN 1d-2s SHELL. Kumar H. Bhatt (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). May 1962. Contract [AT(11-1)-264]. 43p.

Nuclei in the 1d-2s shell were grouped according to their last odd nucleon number. Their properties were examined strictly within the framework of the extreme single particle Nilsson model. The effect of band mixing was included in a consistent way. Properties, such as energy spectra, magnetic moments, and E2 and M1 transitions of odd A nuclei with Z or N = 9, 11, and 13, can be well described by the model. However, when Z or N = 15, it is not possible to fit these properties with a consistent variation of the parameters of the Nilsson potential. Nuclei with Z or N = 17 exhibit low-lying core excitations and therefore the extreme single particle model is not valid for them. (auth)

29753 (IDO-16744) THERMAL NEUTRON CROSS SECTIONS OF THE Co^{58} ISOMERS AND THE EFFECT ON FAST FLUX MEASUREMENTS USING NICKEL. C. H. Hogg, L. D. Weber, and E. C. Yates (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 18, 1962. Contract AT(10-1)-205. 22p.

A large thermal neutron cross section for the product in a nuclear reaction used for neutron flux monitoring in reactors can lead to error. The threshold reaction $Ni^{58}(n,p)Co^{58}$ was utilized to measure fast neutron fluxes. The thermal neutron cross sections of the Co^{58} isomers were measured as 1650 barns for the 71.3-day isomer and 140,000 barns for the 9.1-hr isomer. Tables of correction factors are presented. (auth)

29754 (JAERI-1020) STRUCTURE OF THE NUCLEI ABOVE MASS NUMBER 40. [Conference held at Department of Nuclear Physics, JAERI, July 4 to 6, 1961]. (Japan Atomic Energy Research Inst., Tokyo). 1962. 241p. (In Japanese)

A total of 26 papers is included for which separate abstracts were prepared. The papers contain information on experimental studies by beta-gamma spectroscopy, qualification of nuclear models, and use of nuclear reactions in studies of nuclear structure. (J.R.D.)

29755 (JAERI-1020(p.1-17)) ODD MASS NUCLEI IN THE VIBRATIONAL REGION ($147 \geq A \geq 41$). Kazuo Hisatake (Tokyo Inst. of Tech.). (In Japanese)

Nuclear level energies and electromagnetic transition probabilities in odd A nuclei of $A = 41 \sim 147$ are compiled. Level energy differences between two experimentally assigned shell model orbits, such as $g_{9/2}$ and $p_{1/2}$, are plotted against neutron numbers or proton numbers. The closed shell effects are found. M4, E3, E2, and M1 transition probabilities are tabulated and compared with the single particle transition probabilities derived by Weisskopf and Moszkowski. Most of M4 transition probabilities are 0.1 ~ 0.3 in the Moszkowski unit, whereas M1 transition probabilities are spread between 10^{-1} and 10^{-4} in this unit. Almost all E2 transitions are enhanced by factors of 5 to 300, and E3 transitions are hindered by factors of 10 to 10^4. Some levels seem to have collective natures. (auth)

29756 (JAERI-1020(p.18-25)) LEVELS OF THE ODD MASS NUCLEI IN THE ROTATIONAL REGION. Kasuke Takahashi (Tokyo Univ.). (In Japanese)

Nuclei in the A regions 150 to 190 and $A > 225$ have shapes which deviate essentially from a sphere. The odd-A nuclei in these regions are discussed in the light of recent data from beta and gamma spectroscopy. Topics in these regions, such as newly found isomers, recent information about the hindrance of the orbit-flip magnetic transition, and systematics of the intrinsic states of odd-A nuclei, are discussed. (auth)

29757 (JAERI-1020(p.26-37)) ODD-ODD NUCLEI ($A \geq 40$). Hajime Ohnuma (Tokyo Univ. Inst. for Solid State Physics). (In Japanese)

The recent developments in the studies of odd-odd nuclei ($A \geq 40$) are summarized in the light of contributions to studies of nuclear structure. It is stressed that both the theoretical and experimental information at present are scarce and further studies should be made to clarify the validity of various models and the inter-model problems. Possible experiments for studies of structure of odd-odd nuclei are proposed and their relative advantages are discussed. (auth)

29758 (JAERI-1020(p.38-49)) EVEN-EVEN SPHERICAL NUCLEI. Zyun-ichiro Matsumoto (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

The main features of known vibrational states of the even-even nuclei in the spherical region are summarized. The validity of the interpretation of the low-lying levels as vibrations is checked with the increasing data on 0^+-2^+-4^+ triplet of two-phonon states. Discussions are also made of the three-phonon states. These data are consistent with the prediction of the vibrational model of the liquid drop by Bohr. Splitting of the triplet two-phonon states and the existence of the M1 transition between the 2^+ states of one- and two-phonon excitation would imply the necessity of the refinement of the theory. Attempts made by many investigators in various aspects are introduced briefly. These are the theories by Scharff-Goldhaber and Weneser, Raz, Wilet and Jean, Tamura and Komai, and Davydov and Chaban. Further discussions are included for the excited levels in the transition region and for the negative parity levels by the octupole vibration. (auth)

29759 (JAERI-1020(p.50-4)) ON THE EXCITED STATES OF EVEN-EVEN NUCLEI NEAR THE NEUTRON MAGIC NUMBER 82. Kazusuke Sugiyama (Tohoku Univ., Sendai, Japan). (In Japanese)

A survey was made of the available data for the energy of the lower excited state of even-even nuclei near the neutron number 82. Some characteristic properties on the level order of nuclei in this region are found. It appears that the Davydov model cannot explain the energy levels consistently. The Raz model is applied, and a rather good agreement is obtained. (auth)

29760 (JAERI-1020(p.55-65)) EVEN-EVEN SPHEROIDAL NUCLEI. Mitsuhiro Kawamura (Kyoto Prefectural Univ., Kyoto). (In Japanese)

The experimental work on the even-even spheroidal nuclei since 1958 is surveyed. The systematic behavior of the level spacing, the moment of inertia, and the rotation-vibration coupling strength in the hydrodynamic model are shown graphically. In discussion concerning the electromagnetic transition, it is suggested that the magnitude of K-mixing of the level may be related to the rotation-vibration coupling strength and the experimental and theoretical studies of the E0 transition are very important in order to obtain the information on the β- or γ-vibrational levels. It is also pointed out that the octupole or higher order deformations from the analysis of the electromagnetic transition may not be consistent with that from the analysis of α decay data. Migdal's paper on the moment of inertia and the nuclear gyromagnetic ratio of the excited state based on the superfluid theory is introduced briefly. (auth)

29761 (JAERI-1020(p.66-74)) POSSIBLE BAND STRUCTURES IN NUCLEAR LEVELS. Mitsuo Sakai (Tokyo Univ. Inst. for Nuclear Study). (In Japanese)

Nuclear excited levels studied by analyzing level density diagrams reveal the presence of several break points in the diagram which may correspond to the energies of the beginning of a band structure and appear to vary smoothly with the mass number. The physical meanings of these curves are discussed in connection with the pairing correlation and with the collective excitation. (auth)

29762 (JAERI-1020(p.75-88)) INDEPENDENT PARTICLE MODEL FOR ATOMIC NUCLEI. Hisashi Horie (Tokyo Inst. of Tech.). (In Japanese)

The independent particle model for atomic nuclei is discussed. The single configuration approximation and the Bacher-Goudsmidt method are reviewed as the first approach in this model. The ($d_{5/2}$, $f_{7/2}$) nuclei are examined by this method and the comparison with experiment is given. The introduction of the core concept for spherical nuclei is mentioned, and the resulting selection rules for gamma transitions are discussed. The properties of the residual interaction for the independent particle model are briefly discussed, and the effects of configuration mixing are summarized. Results for the M4 transitions are given in comparison with previous works. The nuclei which were analyzed by the independent particle model are summarized. Special attention was paid to the collective E1 and E3 excitation. (auth)

29763 (JAERI-1020(p.89-96)) GROUND STATE SPINS OF ODD-ODD NUCLEI. Kiyoshi Sasaki (Tokyo Univ.). (In Japanese)

The properties of the ground states of odd-odd nuclei are analyzed by using the j-j coupling shell model. For the

sake of simplicity, the nuclei having one neutron (or one hole) and one proton (or one hole) in the outermost orbit are treated, and the validity of the angular momentum coupling rules for the ground states proposed by Brennan and Bernstein is checked. It is assumed that the interactions between the last neutron (or hole) and proton (or hole) are two-body central potential with a finite range. With the use of this potential, the results agree qualitatively with experiment. Especially, for the nuclei of which the last neutron (or hole) and proton (or hole) are in the same orbit, the charge-dependent potential may be needed to obtain the agreement of the theoretical values with the experimental data of the ground and lower excited states, when Rosenfeld mixture is used for the n-p interactions. (auth)

29764 (JAERI-1020(p.97-113)) SOME PROBLEMS IN THE VIBRATION OF SPHERICAL NUCLEI. Taro Tamura and Takeshi Udagawa (Tokyo Univ. of Education). (In Japanese)

A discussion is presented concerning problems in the collective vibration of spherical even-even nuclei. A brief summary of the various theories of the collective oscillation based on the phenomenological models is given, and discussions of the unsatisfactory points that seem to be inherent to these phenomenological theories are presented. A recent development is also discussed concerning the theory which made it possible to describe the collective vibrational states in terms of the individual particle motion. A detailed account of the formulation of the theory based on the random phase approximation is presented. The results of numerical calculations of the energies of the first 2^+ excited state and the E2 transition probabilities from this to the ground state are also reported. An attempt to extend the theory to the description of the two-phonon state is made. There, a formulation is employed in which the assumption of the random phase is no longer required. (auth)

29765 (JAERI-1020(p.114-22)) RELATIVE PHASE OF E2 AND M1 TRANSITIONS BETWEEN FIRST AND SECOND 2^+ STATES OF THE EVEN-EVEN NUCLEI. Taro Tamura and Hiroshi Yoshida (Tokyo Univ. of Education). (In Japanese)

The relative phase of the M1 and E2 radiations that are mixed in the electromagnetic transition between the first and the second excited 2^+ states in even-even nuclei is calculated. A model is taken in which the states, owing to quasi-particle excitation, are coupled to the originally pure collective states. It is found that this phase is primarily determined by the sign of the magnetic moments of the admixed quasi-particle states and that agreement with experiment is obtained in most of the cases considered. It thus seems that the configuration of the low-lying quasi-particle states is very important in determining the E2 and M1 relative phase both in vibrational and rotational regions. (auth)

29766 (JAERI-1020(p.123-8)) SOME PROPERTIES OF EVEN-EVEN NUCLEI IN THE VIBRATIONAL REGION. Yasukazu Yoshizawa and Mitsuo Sano (Osaka Univ.). (In Japanese)

The energies of the excited states of even-even nuclei and the probabilities of the electromagnetic transitions between them are calculated. The probabilities of the β-transitions between the ground state of an odd-odd nucleus and these states of an even-even nucleus are also calculated. The calculations are performed by assuming that the particles interact with each other through the pairing and quadrupole-quadrupole interactions, by employing the B.C.S. and Sawada approximations, and by taking into account the interaction between the phonon and particle by the perturbation theory. (auth)

29767 (JAERI-1020(p.129-37)) HINDRANCE OF GAMMA TRANSITION PROBABILITY BY PAIRING CORRELATION INTERACTION. [PART] I. Hidetsugu Ikegami (Tokyo Univ. Inst. for Nuclear Study) and Takeshi Udagawa (Tokyo Univ. of Education). (In Japanese)

The hindrance factor for a gamma transition between particle states owing to the pairing correlation is calculated and compared with results for isotopes with neutron or proton number 50 and 82. Good agreements are obtained if a small correction is added to the parameters of Kisslinger-Sorensen. For Cd isotopes, hindrance of gamma transition is calculated using parameters determined by Tamura and Udagawa from the analysis of the first 2^+ states in even-even nuclei and compared in good agreement with experimental values. Comparisons for $Sn^{118}-Cd^{114}$ and $Sn^{118}-Cd^{116}$ pairs revealed no difference between Sn and Cd. (auth)

29768 (JAERI-1020(p.138-41)) HINDRANCE OF GAMMA TRANSITION PROBABILITY BY PAIRING CORRELATION INTERACTION. [PART] II. Takeshi Udagawa (Tokyo Univ. of Education) and Hidetsugu Ikegami (Tokyo Univ. Inst. for Nuclear Study). (In Japanese)

A calculation is made on the hindrance factor of the E2 transition between the 7^- and 5^- states in Sn^{118} when pairing interaction only is taken into consideration. It is clarified that the hindrance occurs as a result of destructive interference between particle transitions $j_1 \rightarrow j_2$ and $j_2 \rightarrow j_1$. The calculated hindrance differs considerably from that by quasi-particle description of Kisslinger and Sorensen. This discrepancy may be considered to come from the non-conservation of particle number in quasi-particle description and from less accuracy of the description in case of small particle number assembly. (auth)

29769 (JAERI-1020(p.142-52)) DAVYDOV MODEL AND NUCLEAR SHAPE. Toshimitsu Yamazaki (Tokyo Univ. Inst. for Nuclear Study). (In Japanese)

The Davydov model is discussed in comparison with the conventional theories. In the deformed region, correspondences of energy levels, gamma transition probabilities, and wave functions between the Davydov model and the Bohr-Mottelson model are shown. The different points between them are pointed out. The similarity of both models is understandable because the zero-point amplitude of γ in the B.M. model is equal to the non-axiality parameter γ in the D.F. model. In the vibrational region, it is shown that the Davydov model cannot explain the low-lying excited states consistently. Some comments on the shape of nuclei and Okamoto's interpretation for fine structure of the giant resonances in photo-nuclear reaction are made. (auth)

29770 (JAERI-1020(p.153-4)) ZERO POINT VIBRATION AND SHAPE OF NUCLEUS. Kazuto Okamoto (Tohoku Univ., Sendai, Japan). (In Japanese)

A quantum-mechanical interpretation of zero-point vibration is reviewed. A remark is made on Yamazaki's interpretation for fine structure of the giant resonances in photo-nuclear reactions. (auth)

29771 (JAERI-1020(p.155-74)) EXPERIMENTS OF INELASTIC SCATTERING OF PARTICLES BY NUCLEI. Kazuhisa Matsuda (Tokyo Univ. Inst. for Nuclear Study). (In Japanese)

A summary is presented of research on the inelastic scattering of particles by atomic nuclei and their dependence on the properties of the final excited state. The Blair model is successful in explaining the diffraction pattern in the angular distribution of (α, α') and (d, d'). Cohen's anomalous scattering is observed in (p, p'), (α, α') and (d, d'). The states strongly excited by anomalous scattering are considered to be of a collective nature. A work on

the inelastic scatterings of 14.5-Mev protons by medium-heavy even-even nuclei is introduced. It was found that there exist strongly excited single levels of about 3.0 to 4.5 Mev besides the first 2^+ states. Their angular distributions fit well with calculations by simple Born approximation and they are assigned to be 3^- states. Their strong excitation is considered to come from the collective property, and their collective parameters are compared with those obtained from Coulomb excitation experiments to find a correlation between them. The excitation energies of these 3^- levels are rather high in the 1 $f_{\frac{7}{2}}$ shell region. A classification is made for the angular distributions of the inelastic scatterings to other levels. It is pointed out that because of the centrifugal barrier a higher incident proton energy is necessary to excite levels of higher spin. Angular distribution measurements should be extended to more forward angles to see the excitation of the 0^+ levels. (auth)

29772 (JAERI-1020(p.175-83)) STUDIES OF NUCLEAR STRUCTURE BY INELASTIC SCATTERING OF NUCLEONS. Tokuo Terasawa (Tokyo Univ. of Education). (In Japanese)

Theoretical considerations are given on the inelastic scattering of nucleons and its relation to the property of the excited state of the target nucleus. When the energy of the projectiles is high, impulse approximation is good and the angular distributions are of the form $|j_l(qR)|^2$. When the projectile energy is lower, distorted wave Born approximation is necessary. With this approximation, a considerable variation of angular distribution with energy would be noted as well as a deviation from the form $|j_l(qR)|^2$, and it would be possible to obtain an agreement with experimental data. It is shown also that the same interactions which make a collective state induce the inelastic scatterings to this state, and such a situation makes the inelastic scattering cross section large. This fact explains the parallelism of inelastic scattering cross sections and gamma transition probabilities. (auth)

29773 (JAERI-1020(p.184-93)) STRIPPING AND PICK-UP REACTIONS. Hiroyasu Ejiri (Tokyo Univ.). (In Japanese)

A report is presented on the status of the stripping and pick-up reactions, in particular, on their relations to the final state of the residual nucleus. With these reactions, the character of the state as single particle state could be investigated. Similarly, a search for cluster property of the nucleus could be made. For heavy (target) nuclei, the distortion effect of the incident wave by nuclear Coulomb, and centrifugal potentials becomes severe. Analysis of this effect has not been carried far enough, though the relations to the structure of the nuclear state are known empirically to some extent. More work is needed to clarify the mechanism of these reactions with heavy nuclei. (auth)

29774 (JAERI-1020(p.194-200)) (p,d) REACTIONS BY 57 Mev PROTONS. Yoshihide Ishizaki (Tokyo Univ. Inst. for Nuclear Study). (In Japanese)

The reactions (p,p), (p,d), (p,t) and (p,α) were measured for C^{12}, Al^{27}, Ni^{58}, Sn, Ag, Au^{197}, and Bi^{209} at E_p = 57 Mev. The report mainly concerns (p,d) reactions. The energy spectra of the emitted deuterons from C^{12}, Al^{27} and Ni^{58} show four peaks, and those from Sn and Ag show two peaks. In the cases of Au^{197} and Bi^{209}, one peak and six peaks are found, respectively. From the Q values corresponding to these peaks and their angular distributions, the shell structures of neutrons in the target nuclei in the ground states can be deduced. (auth)

29775 (JAERI-1020(p.201-2)) PROTON CAPTURE GAMMA RAYS. Yoshio Hashimoto (Tokyo Univ.). (In Japanese)

A discussion is presented concerning (p,γ) low energy reactions in the region of resonance levels and on their validity as a method to the nuclear spectroscopy of heavy nuclei. This method may not work in general, but it should be useful in particular problems since it has various merits other methods do not have. (auth)

29776 (JAERI-1020(p.203-5)) (p,γ) REACTION: INVERSE GIANT RESONANCE. Kazuto Okamoto (Tohoku Univ., Sendai, Japan). (In Japanese)

Usefulness of the (p,γ) reaction is discussed when it is considered as an inverse process of a giant resonance in a (γ,p) reaction. Splitting in a giant resonance indicates the deformation and the intrinsic quadrupole moment of the nucleus. This reaction complements the Coulomb excitation in the measurement of Q_0, in particular in light nuclei. It is also useful in measuring Q_0 of unstable nuclei and of excited states. (auth)

29777 (JAERI-1020(p.206-11)) (n,γ) REACTION. Naomoto Shikazono (Japan Atomic Energy Research Inst., Tokyo). (In Japanese)

Methods of nuclear spectroscopy with gamma rays following neutron capture by nuclei are explained with examples. With medium heavy nuclei, most of the work was done on the capture of thermal neutrons and some with the resonant captures. In many cases, the spectra of capture gamma rays are not resolved enough. Cross structures of the spectra observed are discussed. (auth)

29778 (JAERI-1020(p.212-14)) ANGULAR CORRELATION OF GAMMA RAYS FROM INELASTIC SCATTERING BY NUCLEI. Yasuo Hirao (Osaka Univ.). (In Japanese)

An angular correlation experiment of cascade gamma rays following inelastic scattering of protons is explained in the case of Ar^{40} as an example. For the purpose of spin assignments, angular correlation measurements exceed the angular distribution measurements of the gamma rays from a reaction, since no ambiguity enters from the reaction mechanism. (auth)

29779 (JAERI-1020(p.215-28)) COULOMB EXCITATION. Hiromichi Kamitsubo (Tokyo Univ. Inst. for Solid State Physics). (In Japanese)

The Coulomb excitation of the nucleus is discussed. Usefulness of this method in investigating the low-lying states of the nuclei is explained with examples. There is no question on the property of the interaction, and the absolute transition probability between levels could serve as the work basis. There is a limit on the states which could be excited by this mechanism because of the selection rules involved. Coulomb excitation with heavy projectiles would expand further the utility of this process in nuclear spectroscopy. (auth)

29780 (JAERI-1020(p.229-35)) NUCLEAR REACTIONS BY HEAVY ION PROJECTILES. Kōsuke Nakamura (Tokyo Univ. Coll. of General Education. Inst. of Physics). (In Japanese)

One of the features of reactions with heavy ions as projectiles is that there are many aspects that could be treated semi-classically. Elastic scatterings, inelastic scatterings, Coulomb excitations, and transfer reactions are those having this feature, and they are successfully treated in this way to some extent. Explanations are made of these reactions introducing various models. The theories at present are phenomenological. Quantum mechanical foundations and detailed discussions are yet to be done. This part of nuclear physics is rather new in experiments and many prospects are expected in the future in investi-

gating the reactions themselves and in the application of them to nuclear spectroscopic studies. (auth)

29781 (JINR-P-999) RASSHCHEPLENIE SOSTOYANII V NECHETNONECHETNYKH DEFORMIROVANNYKH YADRAKH. (Splitting of States in Odd-Odd Deformed Nuclei). N. I. Pyatov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 9p.

It is shown that spin-dependent attracting forces of the type $V(|\vec{r}_n - \vec{r}_p|)\vec{\sigma}_n\vec{\sigma}_p$, acting between odd neutrons and protons may be responsible for the coupling of angular momenta and for the doublet structure of levels in odd-odd deformed nuclei. The splitting energy of doublet states in light nuclei was calculated and compared with experimental data. A possibility of violating the Gallagher and Mozkowsky rules in some heavy deformed nuclei is indicated. (auth)

29782 (NP-11955) NUCLEAR g-FACTOR OF THE 113 kev ROTATIONAL LEVEL IN ^{177}Hf. Report No. 156. A. Z. Hrynkiewicz (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). May 1962. 6p.

The nuclear g-factor of the 113-kev state in Hf^{177} was measured using the integral angular correlation method on an external field of 26300 gauss. The value obtained was 0.245 ± 0.032. (J.R.D.)

29783 (NP-11956) ON THE DIFFERENTIAL METHOD OF g-FACTOR MEASUREMENTS OF SHORT-LIVED EXCITED NUCLEAR STATES. Report No. 157. A. Z. Hrynkiewicz (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). May 1962. 12p.

The range of application of the differential method of g-factor measurements of the excited nuclear states and the effect of the finite resolving time of the fast coincidence circuit are discussed. (auth)

29784 (NP-11957) g-FACTOR OF 482 kev of ^{181}Ta MEASURED WITH THE DIFFERENTIAL METHOD. Report No. 158. A. Z. Hrynkiewicz (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). June 1962. 7p.

Magnetic moment measurements were made on the 482-kev state of Ta^{181} by the differential method. A g-factor of 1.336 ± 0.015 was obtained. (J.R.D.)

29785 (ORNL-3306) THE ANGULAR DISTRIBUTION OF FISSION FRAGMENTS FROM THE FAST NEUTRON-INDUCED FISSION OF U-234 (thesis). R. W. Lamphere (Oak Ridge National Lab., Tenn.). Aug. 27, 1962. Contract W-7405-eng-26. 174p.

Submitted to Univ. of Tennessee, Knoxville.

The fast neutron-induced fission cross section of U^{234} was measured from threshold to 4-Mev neutron energy. A maximum of 1.26 barns was found at 850 kev followed by a minimum of 1.10 barns at 1050 kev. The angular anisotropy of the fragment distribution was measured for neutron energies from 400 kev to 4 Mev. Extrema in the ratio $\sigma_f(0°)/\sigma_f(90°)$ were found at 500, 850, and 1050 kev; the distribution at 500 kev showing a maximum in the direction normal to the beam (side-wise peaking) while that at 850 kev showed a maximum along the beam direction. The distribution at 1050 kev showed forward peaking but to a lesser extent than for energies immediately higher or lower. The behavior was analyzed according to the theories of Bohr and Wheeler. The dip in cross section between 850 and 1050 kev is consistent with the suggestion of Wheeler that neutron competition in the decay of the compound nucleus enters with increased strength in this area. Vibration-rotational levels in U^{234} beginning at 790 kev are known to exist and inelastic neutron scattering to these levels serves to depress the fission cross section. The changes in fragment angular distribution are shown to be explainable in terms of the theory of Bohr which states that fission occurs through distinct channels composed of a K-band structure analogous to that observed at low excitations in heavy deformed nuclei. More detailed angular distribution measurements were carried out at 850 and 1050 kev. The overall picture is consistent with a K-band structure in U^{235*} near the saddle point deformation of K equals $^1/_2$+, $^3/_2$−, $^1/_2$− in that order, the bands being separated from each other by a few hundred kilovolts. (auth)

29786 (UCRL-6948) BIVARIATE NORMAL DISTRIBUTION OF CHARGE AND MASS IN SYMMETRIC FISSION AS APPLIED TO THE FISSION OF Au^{197} WITH 112-Mev C^{12} IONS. Harris B. Levy and David R. Nethaway (California. Univ., Livermore. Lawrence Radiation Lab.). June 11, 1962. Contract W-7405-eng-48. 25p.

Blann's radiochemical results on the fission of Au^{197} with 112-Mev C^{12} ions were reanalyzed on the basis that the charge and mass division might follow a bivariate normal distribution function. It is shown that the behavior of Blann's results can be described by relationships derived from such a distribution function for charge and mass. A possible connection between Gaussian distributions for charge and mass and the Minimum Potential Energy Theory of fission is pointed out. (auth)

29787 (UCRL-10046) THEORY OF COLLECTIVE VIBRATIONS OF EVEN-EVEN SPHEROIDAL NUCLEI (thesis). Eugene R. Marshalek (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1962. Contract W-7405-eng-48. 286p.

A version of the Inglis "cranking model" is presented which describes nuclear shape oscillations without the adiabatic approximation. The collective frequencies of a system of particles moving in a time-dependent shell model potential are obtained as solutions of a dispersion equation usually associated with the random phase approximation (RPA). The method used is equivalent to an extension of the cranking model first devised by Araujo. It is shown that the form of the dispersion equation follows from a suitable definition of "vibrational spectrum" in a system with coupled collective and intrinsic degrees of freedom. It is also shown that the generalized cranking model is equivalent to the time-dependent self-consistent field method applied to an appropriate long-range two-body force. Extensive numerical applications are made to quadrupole vibrations of even-even deformed nuclei, using Nilsson's single particle eigenvalues and asymptotic wave functions, and taking residual pairing interactions into account by means of the Bogolyubov canonical transformation method. Vibrational frequencies, mass parameters, force constants, reduced electric quadrupole transition probabilities, and vibration-rotation interaction coefficients of the "β" and "γ" quadrupole modes are theoretically estimated for rare earth and actinide isotopes, and compared with experimental values. (auth)

29788 (UNC-5014(Vol.B)) NEUTRON CROSS SECTIONS FOR BERYLLIUM. Final Report, March 20, 1961–May 31, 1962. A. D. Krumbein (United Nuclear Corp. Development Div., White Plains, N. Y.). May 31, 1962. Contract DA-18-108-CML-1007. 21p. (NDL-TR-36(Vol.B))

Neutron cross sections for energies up to 18 Mev are given for beryllium, along with a brief description of each cross section table. Revisions made in previous compilations are noted and the uncertainties in the existing data are discussed. (P.C.H.)

29789 (WAPD-TM-331) CALCULATION OF THE CONCENTRATIONS AND FISSIONS OF HEAVY ISOTOPES IN TIME-VARYING IRRADIATIONS OF URANIUM AND PLUTONIUM. J. C. Connor (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1962. Contract AT(11-1)-Gen-14. 23p.

Expressions for the concentrations and the number of fissions of 14 heavy isotopes produced in uranium and plutonium irradiations were derived in the form of recursion relations which include the decay of unstable isotopes, assuming a constant flux and arbitrary initial concentrations. The expressions may be used to treat time-varying irradiation histories specified by a sequence of constant flux steps. A three flux-group computer program for this purpose, M0044, is described. The program is written in basic (IBM-704) Fortran II source language. Round-off errors observed for M0044 problems processed on the Philco-2000 computer are presented graphically. (auth)

29790 (AEC-tr-5187) PROSPECTS FOR THE PRACTICAL USE OF ISOMERS. Yu. V. Petrov. Translated from p.329-33 of "Proceedings of the Symposium on Pile Neutron Research in Physics, held in Vienna, October 17-21, 1960." (a publication of the International Atomic Energy Agency, Vienna, 1962. (STI/PUB/36(p.329-33)). 9p.

Reactions of slow neutrons with nuclei in the excited (isomeric) state permit the study of resonances of a compound nucleus in a different energy and spin range from that in which the resonances occur in reactions of slow neutrons with the same nuclei in the ground state. In this case the reaction (n,n') is possible when the escaping fast neutron carries off part or all of the isomer's excitation energy. For some isomers it may happen that the probability of this reaction is comparable with the probability of capture. It is hoped that under certain conditions this reaction can be used for pushing neutrons which are slowing down beyond the threshold of fission of U^{234} and Pu^{240}, and also as a basis for the construction of an experimental reactor with a high flux of monoenergetic neutrons. Various possible uses of such a flux are indicated. (auth)

29791 (AEC-tr-5221) STUDIES OF (n,γ) REACTIONS WITH THE IRT REACTOR. L. V. Groshev, A. M. Demidov, V. N. Lutsenko, and V. I. Pelekhov. Translated from p.261-71 of "Proceedings of a Symposium on Pile Neutron Research in Physics, held in Vienna, October 17-21, 1960." (A publication of the International Atomic Energy Agency, Vienna, 1962). (STI/PUB/36(p.261-71))). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 18437.

29792 (AERE-Trans-897) THE THEORY OF NUCLEAR FISSION. I. NUCLEAR FORCE INTERACTION BETWEEN FRAGMENTS. II. DEFORMATION OF FISSION FRAGMENTS. III. DEPENDENCE OF THE NUCLEAR FORCE INTERACTION AND THE KINETIC ENERGY ON THE DEFORMATION. IV. THE EFFECT OF MAGIC NUMBERS ON NUCLEAR FISSION. W. Brunner and H. Paul. Translated by J. B. Sykes from Ann. Physik (7) 6: 267-78 (1960); Ibid. (7) 7: 326-32(1961); Ibid. (7) 7: 333-41(1961); Ibid. (7) 8: 146-57(1961). 57p.

Part I also available as JPRS-9691.

The Fong-Newton theory of nuclear fission was modified by making explicit allowance for the nuclear forces which act between the fission fragments even after their separation. The fission process takes place via a virtual level of the two-particle system consisting of the two fragments; the height of the level is determined from the observed mean kinetic energy of the fragments. The relative fission probability was identified with the probability of penetrating the potential barrier resulting from the combination of the nuclear force and the Coulomb force. The magnitude of the nuclear force interaction was determined from the requirement that the theory should reproduce the mass distribution occurring in fission. The values thus obtained were of the expected order of magnitude; their variation with the mass ratio of the two fragments seemed to be related to the formation of closed shells in the fragments. The total excitation energy $\widetilde{E}$ of the two fragments was calculated for the fission of U^{235} by thermal neutrons, using the law of conservation of energy, Fong's mass formula for the primary fission products, and the experimental values for the mean kinetic energy of the fragments. This energy has a pronounced minimum in the case where one of the fragments lies in the neighborhood of the magic nuclei ($N = 82$, $Z = 50$). On the assumption that $\widetilde{E}$ is distributed between the two fragments in the ratio of their masses, the deformation of the fragments was determined from $\widetilde{E}$ by means of the simple droplet model, but with allowance for the dependence of the surface tension on the shell structure. The deformation parameter of a fragment, regarded as a function of the number of neutrons in the nucleus, exhibited characteristic steep decreases for the magic neutron numbers. Considerations concerning the theory of nuclear fission led to the concept of a nuclear force potential acting between the two fragments whose depth V_K^0 depends on their shell structure. From the quantitative variation of V_K^0 as a function of the mass ratio of the fragments it was deduced that the deformation of the fission products "at the moment" of their formation, on the assumption that the shell structure operates mainly through the mechanism of a deformation of the fragments to an extent depending on the nucleon configuration. The result is in very good agreement with the result of an earlier and completely independent semi-empirical calculation of the same deformation. It is also possible to obtain from the same values of the deformation parameters a quantitative understanding of the experimental values of the kinetic energy of the fragments, which are an important parameter of the theory. The ideas concerning the theory of nuclear fission successively developed are systematically presented. From the basic concept of a deformation of the fragments, dependent on shell structure, 'at the moment' of separation, there follow magic effects in the nuclear force potential between the two fragments and the mean kinetic energy of the fragments; the combination of these effects allows a quantitative understanding of the observed asymmetry of fission. As an illustration, the spontaneous fission of Cf^{252} is discussed. The symmetrical fission of Bi^{209} by deuterons is also explained. Finally, a qualitative explanation is given, on the basis of the general ideas previously developed, for the known reduction in the asymmetry of fission when the excitation energy of the fissile nucleus is increased. (auth)

29793 (FTD-TT-62-953) MEASUREMENT OF THE CROSS SECTIONS OF INELASTIC NEUTRON COLLISIONS WITH THE NUCLEI OF CHROMIUM, IRON, NICKEL, NIOBIUM, AND MOLYBDENUM AT ENERGIES TO 2.6 Mev. A. I. Abramov. Translated from Atomnaya Energ., 12: 62-4(Jan. 1962). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 10984.

29794 (UCRL-Trans-847(L)) ON THE DEPENDENCE OF THE IONIZATION PROBABILITY OF $H_2 \rightarrow H + H^+ + e$ + KINETIC ENERGY, ON THE ORIENTATION OF THE MOLECULE TOWARD THE COLLIDING ELECTRON.

Nobuji Sasaki and Tsuneyo Nakao. Translated by F. S. Baker (Univ. of California Lawrence Radiation Lab., Berkeley) from Proc. Imp. Acad. (Tokyo), 11: 138-40 (1935). 4p.

Studies were made of the dissociation of hydrogen molecules in electron beam collisions to determine if the ionization probability depends on the orientation of the molecule toward the colliding electron. Results indicated that ionization probability does depend on direction. (M.C.G.)

29795 (UCRL-Trans-849(L)) MOLECULAR ORIENTATION AND THE DISSOCIATION PROBABILITY OF THE HYDROGEN MOLECULE BY ELECTRON IMPACT. Nobuji Sasaki and Tsuneyo Nakao. Translated by F. S. Baker (Univ. of California, Lawrence Radiation Lab.), from Proc. Imp. Acad. (Tokyo), 17: 75-7(1941). 5p.

The orientation effect was assumed in the case of the electron collision dissociation of $H_2 \rightarrow H + H^+$ in order to quantitatively measure the angular dependence by a completely different experimental method than previously used. In the experimental setup hydrogen flows into the apparatus through a small hole. The direction of flow is along the apparatus axis. The direction of the electron beam and that of the series of orifices of the ion detector cylinder are both perpendicular to the axis of the apparatus and intersect at a point above the hydrogen hole. The angle θ subtended by the two directions is arbitrarily variable by rotating the electron gun about the apparatus axis. The ion collector consists of a Faraday cage the orifice of which is preceded by a series of three fixed diaphragms in each of which there is a small hole. At every angle θ the ion current was measured at 5 and 9 volts. The results were in excellent agreement with theory. (M.C.G.)

29796 AN INELASTIC NEUTRON SCATTERING EXPERIMENT. Eddie Ortiz (Puerto Rico Nuclear Center, Mayaguez). Am. J. Phys., 30: 634-6(Sept. 1962).

A recording spectrometer with a NaI crystal scintillator, a neutron source, and an iron scatterer were used to measure the gamma ray at 0.84 Mev from Fe^{56} by inelastic scattering of fast neutrons. (auth)

29797 A STUDY OF THE E0 ADMIXTURE AND M1 PENETRATION MATRIX ELEMENT OF THE 333 Kev $2+ \rightarrow 2+$ TRANSITION IN Pt^{196}. T. R. Gerholm, M. S. El-Nesr, E. Bashandy, and B.-G. Pettersson (Univ. of Uppsala). Arkiv Fysik, 21: 241-52(1962).

The 333 kev $2+ \rightarrow 2+$ transition in Pt^{196} has been studied with an electron-gamma angular correlation spectrometer of novel design. The angular correlations confirm earlier results obtained at this institute. The values are $A_2(333\gamma - 356e) = +0.115 \pm 0.006$ and $A_2(333e - 356\gamma) = -0.075 \pm 0.006$. In addition the electron-gamma coincidence method was used for an absolute determination of the following two conversion coefficients: $\alpha_K(356) = 0.041 \pm 0.003$, pure E2 in Pt^{196}; and $\alpha_K(333) = 0.056 \pm 0.003$, E0 + M1 + E2 in Pt^{196}. The conversion coefficient of the 356 kev pure E2 transition was found to be in agreement with the theoretical value. In view of recent results indicating large anomalies in the conversion process of inhibited M1 transitions, the analysis has been extended to large values of the parameter λ. Two solutions appear, namely $q = \sqrt{(E0 \text{ conv. prob.}/E2 \text{ conv. prob.})} = 0.43 \pm 0.05$, which, if $W_\gamma(2+ \rightarrow 2+)/W_\gamma(2+ \rightarrow 0+) = \frac{1}{2}$ in analogy with Pt^{194}, corresponds to $\rho = 0.016 \pm 0.002$ and $\lambda = 27 \pm 13$, or $q = \sqrt{(E0 \text{ conv. prob.}/E2 \text{ conv. prob.})} = -0.110^{+0.145}_{-0.110}$ which, under the above-mentioned assumption, gives $\rho = -0.004^{+0.005}_{-0.004}$ and $\lambda = 91.5 \pm 5$. Comparison with recently obtained results for the conversion ratios of the corresponding transitions in Pt^{194} favors the first alternative. Finally, some comments are given on the significance of the E0 admixture in connection with the asymmetric rotor model and the vibrational model. (auth)

29798 EXPERIMENTAL STUDIES OF E2 CONVERSION COEFFICIENTS. W. F. Frey, J. H. Hamilton, and S. Hultberg (Vanderbilt Univ., Nashville). Arkiv Fysik, 21: 383-408(1962).

Internal conversion coefficients of E2 transitions from the decays of Co^{60}, Co^{58}, Sc^{46}, Ir^{192}, and Au^{198} have been measured with the internal-external conversion method. The experimental K and/or (K + L + M) internal conversion coefficients of the $2+ \rightarrow 0+$ and $4+ \rightarrow 2+$ unhindered E2 transitions measured in the Co^{60}, Co^{58}, and Sc^{46} decays agree well with theoretical E2 values. In the Ir^{192} studies, the α_K values for the two $2+ \rightarrow 0+$ transitions were in agreement with and 4% lower than theoretical E2 values and for the four essentially E2 transitions, two were in agreement with and two were 4 and 10% lower than the theoretical E2 values. However, the deviations are well within experimental errors. The measured α_L values for three transitions in Pt^{192} agreed with the theoretical E2 values and the only α_M measured was 40% lower than the theoretical E2 value. The α_K for the $2+ \rightarrow 0+$ 412-kev transition in Hg^{198} was found to be about 6% lower than the theoretical E2 value. The present result averaged with other results indicates for the 412-kev transition $\alpha_K = (285 \pm 6) \times 10^{-4}$ which is about 5% lower than the theoretical E2 value. Thus, in the low Z range experimental E2 conversion coefficients are in good agreement with theory and for Z about 80 there is agreement in some cases, and slight deviations in other cases (of the order of 5%). (auth)

29799 THE MAGNETIC MOMENT OF INDIUM-115m. J. A. Cameron, H. J. King, H. K. Eastwood, and R. G. Summers-Gill (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 40: 931-42(Aug. 1962).

The hyperfine structure of the 4.5-hour metastable state of In^{115} is studied by the method of atomic beam magnetic resonance. The values found for the hyperfine interaction constants are -903.5 ± 1.1 and -95.973 ± 0.010 Mc in the $^2P_{\frac{1}{2}}$ and $^2P_{\frac{3}{2}}$ electronic states respectively. Neglecting a possible hyperfine anomaly, these correspond to a nuclear magnetic moment for In^{115m} of -0.24371 ± 0.00005 nuclear magnetons. The construction of the atomic beam apparatus is also described. (auth)

29800 STRUCTURE IN THE MASS-YIELD DISTRIBUTION FOR U^{235} FISSION. H. Farrar and R. H. Tomlinson (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 40: 943-53(Aug. 1962).

Measurements of the cumulative yields of essentially all the mass chains in the thermal neutron fission of U^{235} enable a detailed examination of the fine structure in the mass-yield curve. It is found that most of the structure results from a slowly changing neutron yield as a function of the mass of the primary fission fragments. (auth)

29801 SHORT-LIVED ISOMERIC STATES OF POLONIUM. C. K. Hargrove and W. M. Martin (McGill Univ., Montreal). Can. J. Phys., 40: 964-77(Aug. 1962).

Two nuclear isomeric states are discovered in Po^{207} by the reaction $Bi^{209}(p,3n)Po^{207m}$, and information is found on an isomer in Po^{205} produced by the reaction $Bi^{209}(p,5n)Po^{205m}$. A 47-μsec activity is found in Po^{207}, which is assigned as the decay of a $\frac{13}{2}+$ level by 310-kev M2 radiation to a $\frac{9}{2}-$ level, followed by an 820-kev E2 γ ray to the $\frac{5}{2}-$ ground state. The $\frac{13}{2}+$ level in this nucleus

is found to be fed by a 2.8-sec isomeric state, which is assigned to the decay of a $^{13}/_{2}-$ level by 260-kev E3 radiation. A 160-kev γ ray is discovered in the Po^{205} isomer. This isomerism is caused by a $^{13}/_{2}+$ state, which decays by a 160-kev M2–707-kev E2 cascade to the $^{5}/_{2}-$ ground state through a $^{9}/_{2}-$ level. The various multipolarity assignments are supported by measurements of intensities, lifetimes, and K conversion coefficients. The levels found are compared with similar levels in analogous nuclides of lead. (auth)

29802 CUMULATIVE YIELDS OF LIGHT FRAGMENTS IN U^{235} THERMAL NEUTRON FISSION. H. Farrar, H. R. Fickel, and R. H. Tomlinson (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 40: 1017-26(Aug. 1962).

A mass spectrometric study of the relative yields of the strontium, yttrium, zirconium, and molybdenum isotopes formed in the thermal neutron fission of U^{235} makes possible a detailed examination of structure of the light mass region of the mass-yield curve. The relative yields are normalized to 5.77% for Sr^{90}, causing the fission yields to total 100.8%. (auth)

29803 THE NUCLEAR SPIN OF INDIUM-117m. J. A. Cameron and R. G. Summers-Gill (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 40: 1041-3(Aug. 1962).

The atomic beam magnetic resonance method is used to determine the nuclear spin of 1.9-hr In^{117m} as $I = {}^{1}/_{2}$. Results are also found that are consistent with, but do not prove, an assignment of $I = {}^{9}/_{2}$ for the ground state of In^{117}. (T.F.H.)

29804 THE HALF-LIVES OF K^{42} AND Br^{82}. Janet S. Merritt and J. G. V. Taylor (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 1044-6(Aug. 1962). (AECL-1553)

The half lives of K^{42} and Br^{82} are determined to be 12.358 ± 0.007 and 35.344 ± 0.013 hr respectively. (T.F.H.)

29805 NEUTRON CROSS SECTION OF BERYLLIUM NEAR 200 kev. André Perrin, Georges Surget, Claude Thibault, and Francoise Verrière. Compt. rend., 255: 277-8(July 9, 1962). (In French)

A time-of-flight apparatus, associated with a 2-Mev Van de Graaff generator and permitting the easy separation of neutrons directly from the background, was utilized to measure the total cross section. The cross section of Be has, for an energy of 207 kev, a resonance probably due to s neutrons. (tr-auth)

29806 MEASUREMENT OF THE CIRCULAR POLARIZATION OF GAMMA-QUANTA EMITTED FROM THE NUCLEI AFTER THE CAPTURE OF POLARIZED THERMAL NEUTRONS. R. Michalec (Moscow State Univ.) and T. Ruskov. Czechoslov. J. Phys., 12: 325-7(1962). (In Czech.)

Published data predict that non-polarized nuclei, after capturing polarized thermal neutrons, form polarized compound nuclei with isotropic emission of circularly polarized γ quanta. The degree and sign of γ polarization are functions of the transition multiplicity and the initial moments of composite and final nuclear states. The circular polarization of γ quanta emitted by Fe^{57} at $E_\gamma = 7.64$ Mev and Ni^{59} at $E_\gamma = 9.0$ Mev was measured for calibrating the installation. For iron $P = 2.52 \times 10^{-2}$, $Q = 0.47 \pm 0.22 \times 10^{-2}$, and for nickel $P = 1.16 \times 10^{-2}$, $Q = (-0.54 \pm 0.27) \times 10^{-2}$; the results obtained for the two transitions were in good agreement with published data. Measurements were also made of the circular polarization of γ-quanta emitted by Cu^{64} where the Cu^{63} has two closely distributed levels at resonance energies 0.59 and 2.0 kev that are responsible for the thermal neutron capture. The observed three very intense and closely distributed transitions of Cu^{64} ($E_\gamma = 7.91$, 7.63, and 7.31), measured as a total γ circular polarization, were equal to $P_\Sigma = 2.52$, $R_\Sigma = 10^{-2}$, and $Q = (-0.08 \pm 0.10) \times 10^{-2}$. On the basis of published data and correlations of R_Σ, obtained by theoretical and experimental data on Q, it was concluded that all three transitions have L = 1(E1), while resonance spins at 0.59 kev and 2.0 kev have different magnitudes differing by a unit (2^- or 1^-). (R.V.J.)

29807 SATURATION OF NUCLEAR FORCES IN BRUECKNER THEORY. J. Blank (Faculty of Technical and Nuclear Physics, Prague). Czechoslov. J. Phys., 12: 417-31(1962). (In English)

The basic equations in the Brueckner theory of nuclear matter are solved for a two-nucleon potential taken as a rectangular well with a rectangular repulsive sphere, and the properties of the solutions are investigated for various dimensions of the repulsive sphere. The two-nucleon interaction is considered to be non-vanishing only if the nucleons are in the S-state. Under such assumptions a two nucleon potential always gives saturation, i.e., a minimum of the mean binding energy per nucleon, at a finite nuclear density. It is shown that the nuclear density and the mean binding energy decreases if the height or the width of the repulsive sphere increases. If the repulsive sphere is infinitely high a nucleus can exist as a bound state only if the width of this sphere is sufficiently small. The limit value for the width of the sphere is given. It is shown how the solution of the basic equations changes if the two-nucleon potential does not contain an infinite repulsive sphere, but only a very large one. (auth)

29808 PROTON POLARIZATION IN $Be^{9}(d,p)Be^{10}$. John Allen Green (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 23: 273-4(July 1962).

The polarization of the protons from the stripping reaction was detected by a conventional helium polarimeter. Protons scattered from helium at an energy corresponding to the $P_{\frac{1}{2}}$ resonance in Li^{5} were detected by eight nuclear emulsions arranged in azimuth around the proton beam. The polarization was then obtained from the measured asymmetry and the known properties of the p-α scattering. A set of quadrupole magnets allowed considerable shielding to be used without a loss of intensity. Proton groups from the ground and excited states of Be^{10} were separated before entering the polarimeter by a low resolution analyzer magnet. The sign of the polarization near the stripping peak ($\vartheta_{cm} = 20°$) is in accord with the empirical rule that $P = (\pm)$ when $j_n = l_n \pm {}^{1}/_{2}$. On the basis of the DWBA theory involving spin-independent distortion of the deuteron and the proton, the maximum predicted polarization is $P_{max} = 0.17$. This limit is clearly violated both above and below the stripping peak, indicating the presence of spin-dependent forces. In the approximation that the deuteron and proton are only weakly distorted by the nuclear potentials, the radial cutoff form of the DWBA theory predicts that the polarization will change sign where the plane-wave cross section has its first minimum. Experimentally, the polarization changes sign at $\vartheta_{cm} = 71° \pm 4°$ while the first minimum of the Butler cross section for $l_n = 1$, $r_0 = 5.2$ f occurs at 60°. This indicates that contributions from the nuclear interior, and distortion of the deuteron and proton constitute an important part of the total stripping amplitude. The magnitude of the polarization at 44.6° is again in excess of the maximum ($P_{max} = -0.33$) predicted by the spin-independent DWBA theory. The sign of the polarization indicates the reaction proceeds predominantly by the neutron coupling scheme $j_n = {}^{1}/_{2} = l_n - {}^{1}/_{2}$. Near the stripping peak ($\vartheta_{cm} = 20°$), the polarization meas-

urements compare favorably with (d,py) results and indicate that the reaction is mainly of a plane-wave nature at this angle. Data are tabulated.

29809 MEASUREMENT OF THE SPIN OF NITROGEN-13 BY ATOMIC BEAM METHODS. Martin Posner (Princeton Univ., N. J.). Dissertation Abstr., 23: 275 (July 1962).

A new focusing atomic beam apparatus was built and used to measure the nuclear spin of nitrogen-13. The apparatus uses a permanent six-pole focusing A-magnet and a permanent two-pole deflecting B-magnet. The major problems to be overcome in the nitrogen-13 work were: production and transportation of nitrogen-13 from the Princeton cyclotron to the atomic beam apparatus; and production and collection of an atomic beam of nitrogen. The nitrogen-13 was produced by proton bombardment of a melamine powder target and flushed continuously out of the target and down a 400 ft pipe-line to the atomic beam apparatus using neon as the flushing gas. The nitrogen-13 activity was produced in a molecular form; a magnetron-powered microwave discharge in the neon flushing gas was used to dissociate the molecular vapor for the atomic beam source. The atomic beam was collected on thin foils of iron, niobium, and titanium heated to about 1050°C. In the final phases of the experiment a special detector chamber was used to isolate the target foils from the large background of nitrogen-13 atoms in the B-magnet. Resonances were observed at nine different values of magnetic field up to about 1.5 gauss. The measured resonance frequencies are consistent only with F = 0 transitions in the hyperfine multiplets F = 2 and F = 1 for I = 1/2 and J = 3/2. Observation of F = 0 transitions at higher magnetic fields in measurement of the magnetic moment of nitrogen-13 confirms the spin assignment of 1/2. The results of the higher field data for the zero-field hyperfine splitting and nuclear magnetic moment of nitrogen-13 are: $\Delta\nu$ = (33.17 ± 0.42) mc/s and $|\mu_I|$ = (0.320 ± 0.004) nm.

29810 EMISSION OF THE NUCLEI Li^8 AND Li^9 PRODUCED BY A BEAM OF 17 Bev/c π^- IN THE HEAVY NUCLEI OF IONOGRAPHIC EMULSIONS. G. Baumann, H. Braun, and P. Cuer (Centre Nucleaire, Strasbourg). J. phys. radium, 23: 335-6(May 1962). (In French)

In a study of the stars produced from the exposure of G 5 nuclear emulsions to 17 Bev/c π^- mesons, a number were observed with emission of "hammer" tracks with a production rate of 1.1%. A measurement of the track lengths show that 97% are caused by Li^8 and Li^9. The energy distribution in the laboratory system behaves according to the evaporation theory for fragments with energy below 40 Mev. The theoretical evaporation curve was calculated, and it was found that the parameters giving the best agreement with the experimental results are T = 8 Mev, V = 8 Mev, and p = 0.0015 × c. For the same fragments, the isotropic angular distribution in the center of mass agrees with that predicted by the evaporation theory. Fragments with energy above 40 Mev are more numerous than theory predicts. No noticeable difference was found between the emission of Li^8 and Li^9 from interactions with 25-Bev/c protons and interactions with 17-Bev/c π^-. (J.S.R.)

29811 THE EFFECTS OF REACTIONS ON ELASTIC SCATTERING. Fernando B. Morinigo (California Inst. of Tech., Pasadena). Nuclear Phys., 36: 529-41(Aug. 1962). (In English)

The behavior of the phase shifts as a function of momentum when reaction channels are present may be reduced to the case of elastic scattering with no reactions. This is done by subtracting a quantity which may be calculated from a detailed knowledge of total reaction cross sections. Using this analysis, it is found that the essential parameters of the subtracted phase shift represent complex values of the momentum for which the compound system would be perfectly black. A two-channel model, having a number of true resonances, is solved explicitly, and the phase shifts of the uncoupled problem are compared to the results obtained in the coupled problem when the anomalies are subtracted, for appropriate values of the coupling parameter and channel threshold. The model allows estimates to be made of the possible errors introduced, in a practical situation, by an incomplete knowledge of the reaction cross sections. (auth)

29812 THERMAL NEUTRON ACTIVATION CROSS-SECTIONS FOR ISOMER PRODUCTION. S. K. Mangal and P. S. Gill (Gulmarg Research Observatory, India and Muslim Univ., Aligarh, India). Nuclear Phys., 36: 542-8(Aug. 1962). (In English)

Thermal neutron activation cross sections for the following cases have been measured by making irradiation with the "Swimming pool" reactor at Trombay, Bombay, with the following results:

$Pt^{196}(n,\gamma)Pt^{197m}$(69 ± 20% mb); $Os^{188}(n,\gamma)Os^{189m}$(8 ± 25% mb);
$W^{184}(n,\gamma)W^{185m}$(22 ± 20% mb); $Dy^{164}(n,\gamma)Dy^{165}$(951 ± 25% b);
$Te^{122}(n,\gamma)Te^{123}$(161 ± 15% mb); $Te^{128}(n,\gamma)Te^{129}$(178 ± 15% mb);
$Te^{128}(n,\gamma)Te^{127}$(1034 ± 15% mb); $Cd^{114}(n,\gamma)Cd^{115}$(< 8 mb);
$Cd^{108}(n,\gamma)Cd^{109}$(1410 ± 25% mb); $Cd^{114}(n,\gamma)Cd^{115m}$(132 ± 15% mb);
$Zn^{70}(n,\gamma)Zn^{71m}$(9 ± 20% mb); $Zn^{68}(n,\gamma)Zn^{69}$(111 ± 20% mb);
$Zn^{64}(n,\gamma)Zn^{65m}$(83 ± 15% mb); $Zn^{64}(n,\gamma)Zn^{65}$(1116 ± 15% mb).

The activation method was employed for these measurements. (auth)

29813 VARIATIONS OF THE DECOUPLING PARAMETERS FOR ½ ROTATIONAL BANDS FOR VERY DEFORMED NUCLEI. J. Valentin (Faculté des Sciences, Orsay, France). Nuclear Phys., 36: 549-63(Aug. 1962). (In French)

The assumption of a ½ rotational band requires a great deal of calculation in order to check the agreement of theoretical and experimental values of the "decoupling parameter" (which, in turn, is a function of 5 parameters). The values of the decoupling parameter a as a function of the deformation η for all compatible combinations of the original 5 parameters are given. The curves a = f(η) are plotted for several values of μ. As a consequence, if a is very sensitive to the deformation, the relation may be reversed in order to obtain accurate values for η (and hence, also for the intrinsic quadrupole moment). (auth)

29814 THE SHAPE OF THE INTENSE Au^{198} BETA SPECTRUM AND THE K CONVERSION COEFFICIENT OF THE 412-kev TRANSITION. J. H. Hamilton (Vanderbilt Univ., Nashville), R. V. Stockendal, D. C. Camp, L. M. Langer, and D. R. Smith. Nuclear Phys., 36: 567-77(Aug. 1962). (In English)

The intense beta spectrum of Au^{198} and the K internal conversion coefficient of the 412-kev transition were measured. The beta spectrum was found to have a nonstatistical shape which can be best fitted with a once-forbidden shape factor of the form $1 - 0.33\ W + 0.074\ W^2$. With this shape factor used to determine the total intensity of the beta spectrum and thereby the intensity of the gamma radiation, the K internal conversion coefficient of the 412-kev transition in Hg^{198} is found to be $\alpha_K = (282 \pm 10) \times 10^{-4}$. On the basis of a statistical shape for the beta spectrum a value of 297×10^{-4} would be obtained. (auth)

29815 POLARIZATION MEASUREMENTS ON THE 5.83 → 5.10 Mev GAMMA TRANSITION IN N^{14}. H. J. Rose,

F. Uihlein, F. Riess, and W. Trost (Universität, Freiburg i. B.). Nuclear Phys., 36: 583-96(Aug. 1962). (In English)

An experiment has been made to obtain information about the relative parity of the 5.83 Mev and 5.10 Mev states in N^{14}. Using the reaction $C^{13}(p,\gamma)N^{14}$ at the 1.47 Mev resonance, measurements have been made to determine the plane polarization of the 0.73 Mev gamma ray due to the transition from the J = 3, 5.83 Mev state to the J = 2, 5.10 Mev state. If the transition is mainly dipole in character, as has been concluded by Warburton, Rose and Hatch from a Doppler shift measurement on the 0.73 Mev gamma ray, the results of the present measurements give conclusive evidence that it must be M1 (with possible small admixtures of E2) and, hence, that the 5.83 Mev and the 5.10 Mev state have the same parity. In as much as a preference for an odd-parity assignment of the 5.83 Mev state is indicated by previous work, this preference, then, is also given for the 5.10 Mev, J = 2 state. Further polarization measurements on the Ni^{60} 1.17 Mev gamma radiation and the 0.42 Mev radiation following the Coulomb excitation of $Ag^{107/109}$ have been made in order to calibrate the polarimeter. (auth)

29816 Li^7 + p INTERACTION AND EXCITED STATES OF Be^8. S. Cavallaro, R. Potenza, and A. Rubbino (Università, Catania, Italy and Centro Siciliano di Fisica Nucleare, Catania, Italy). Nuclear Phys., 36: 597-614(Aug. 1962). (In English)

The Li^7 + p interaction has been extensively studied and its various products analyzed. The results confirm the presence of the well known levels of Be^8 at 2.9, 17.63, and 18.15 Mev and give clear evidence for the existence of the discussed 7.56 Mev level. Three new levels of Be^8 have been discovered at the energies 13.91, 17.9, and 18.0 Mev. Widths, angular momenta, parities, and isobaric spins of several levels have been determined. Some anomalies of the Li^7 + p interaction, previously observed by others, are explained. (auth)

29817 INTERACTION OF DEUTERONS WITH O^{16} AND Ni^{58}. S. Mayo and J. E. Testoni (Comisión Nacional de Energía Atómica, Buenos Aires). Nuclear Phys., 36: 615-30(Aug. 1962). (In English)

Absolute cross sections for the reactions $O^{16}(d,d)O^{16}$ ground state, $O^{16}(d,p)O^{17}$ ground and 0.872 Mev states at 26.3 Mev deuteron energy, and for the reactions $Ni^{58}(d,d)Ni^{58}$ ground state, $Ni^{58}(d,d')Ni^{58}$ 1.45 Mev state, and $Ni^{58}(d,p)Ni^{59}$ ground state at 27.5 Mev bombarding energy were measured by using the scintillation technique with a resolution in energy of 2.5 to 3%. A simple analysis of the elastic interactions was performed in terms of a Fraunhofer-type diffraction model resulting in an interaction radius of 4.9 ± 0.6 fm and 5.9 ± 0.6 fm for O^{16} and Ni^{58}, respectively. The inelastic interaction measured was analyzed in terms of the Huby and Newns model; the best fit was obtained by the addition of two l-value contributions since with a unique l-value it was not possible to fit the experimental points. The stripping reactions measured were analyzed in terms of the Butler theory; it was found that the best fit was obtained by the addition of two l_n-value contributions since a unique l_n-value did not describe the experimental points. (auth)

29818 DIFFERENTIAL CROSS SECTIONS FOR (d,α) AND (d,t) REACTIONS IN Be^9. J. A. Biggerstaff, R. F. Hood, H. Scott, and M. T. McEllistrem (Univ. of Kentucky, Lexington). Nuclear Phys., 36: 631-41(Aug. 1962). (In English)

The $Be^9(d,\alpha)Li^7$ reaction to the ground and first excited states of Li^7 has been studied in the energy range 0.4 Mev ≦ E_d ≦ 2.4 Mev. The $Be^9(d,t)Be^8$ reaction has been studied from 0.86 Mev < E_d < 2.2 Mev. Total cross sections for the $Be^9(d,p)Be^{10}$ reaction are presented to relate previously published angular distribution data to other Be^9 + d reactions. The cross sections for the $Be^9(d,\alpha)Li^7$ transitions are comparable over the entire energy range and excitation functions for the two transitions show no obvious indication of resonances. Angular distributions for the two transitions are nevertheless dissimilar over the entire energy range. The (d,α) cross sections are observed to be approximately three times as large as the (d,p) cross sections. (auth)

29819 DECAY OF Sr^{89}. Allan R. Sattler (Pennsylvania State Univ., University Park). Nuclear Phys., 36: 648-51 (Aug. 1962). (In English)

The decay of Sr^{89} was re-investigated in an effort to find a ≈ 10 d isomeric state previously reported. No appreciable production of such an isomer by means of neutron capture has been observed. In addition a 0.913 Mev gamma ray activity with a measured half life of 50.1 ± 3.4 d, attributed by some investigators to the decay of Sr^{89}, was confirmed by half life experiments. The half life of Sr^{89} was determined to be 53.6 ± 0.4. The nucleus Sr^{89} decays to Y^{89m} to the extent of ≈ 0.01%. (auth)

29820 RADIOACTIVE DECAY OF Ir^{195}. A. B. Claflin, R. T. White, and M. L. Pool (Ohio State Univ., Columbus). Nuclear Phys., 36: 652-5(Aug. 1962). (In English)

Osmium metal enriched to 98.68% in the mass number 192 was irradiated with 24 Mev alpha particles. An activity with a half life of 4.2 ± 0.1 h was produced and its assignment to Ir^{195} confirmed by identification of the platinum K x ray. In addition to the x rays the observed activity of Ir^{195} consists of gamma rays of 190 and 290 kev in coincidence. Transition probabilities are shown in a proposed energy level diagram. (auth)

29821 DISTORTED WAVE EFFECTS IN PROTON INELASTIC SCATTERING. T. J. Menne (Univ. of California, Los Angeles). Nuclear Phys., 36: 656-65(Aug. 1962). (In English)

The direct-interaction differential cross section for the inelastic scattering of protons on complex nuclei is determined in the distorted wave Born approximation. The incoming and going wave functions are assumed to have the simple, analytical form originally suggested by McCarthy and Pursey, and are designed to simulate the distortion effects of the nuclear optical potential. These wave functions include a focus term, which is quite strong for protons, and which is capable of reproducing the observed shape of the differential cross section at intermediate and back angles. The amplitude of the focus term is assumed to have a Gaussian distribution about the focal point as center. A check against experiment is made for a number of intermediate-weight nuclei and carbon, at medium energies. Good results are obtained except for the forward scattering region. A comparison between the parameters of this theory and those which can be determined from optical model wave functions is also included. (auth)

29822 ROTATIONAL ENERGIES FOR THE ASYMMETRIC ROTOR MODEL FOR ODD-MASS NUCLEI. Lucy Wu Person (Univ. of California, Berkeley) and John O. Rasmussen. Nuclear Phys., 36: 666-87(Aug. 1962). (UCRL-9876). (In English)

The effect of ellipsoidal nuclear deformation in odd-mass-nuclear rotational band structure, the magnetic moment, and electric quadrupole reduced transition probabilities is studied. Also, the relationship between the

rotational bands of an ellipsoidally deformed nucleus and the vibrational and rotational bands of a spheroidally deformed nucleus with γ-vibration-rotation interaction in the limit of γ approaching 0 or $\frac{1}{3}\pi$ is pointed out. Equations for the asymmetric rotor motion are derived. By using T. D. Newton's single-particle eigenvalues and eigenvectors, numerical calculations are presented showing rotational spectra associated with an odd nucleon in an ellipsoidal well. The calculations for the N = 4 and N = 2 shells were done on an IBM 709 computer. Numerical results are discussed in terms of the β and γ deformation parameters required to give the known spins of the odd-mass cesium isotopes Cs^{127} to Cs^{137}. The rotational energy spectrum, magnetic moment of ground state, and various E2 transition probabilities are calculated for Cs^{131} for several deformations, with best energy spectrum fit at $\beta = 0.28$, $\gamma = 38$ deg. There are difficulties with the transition probabilities and magnetic moment. (auth)

29823 NEUTRON DATA FOR REACTOR KINETICS. 1. DELAYED NEUTRONS FROM FISSION. 2. PHOTONEUTRONS FROM D_2O AND BERYLLIUM. G. Robert Keepin (Los Alamos Scientific Lab., N. Mex.). Nucleonics, 20: No. 8, 150-6(Aug. 1962).

1. Tables are given summarizing the Los Alamos results for the delayed neutron periods, abundances, and yields from several fissioning species. A plot of the yield vs energy of neutron inducing the fission is made for the post-1956 data, and a plot of log yield vs A−3Z, where A = mass number and Z = atomic number of fissioning nucleus, gives a straight line for all species. Data on energies of delayed-neutron groups and on composite delayed-neutron spectra are compared. Delayed-neutron fractions of the total neutron yields are tabulated for the main fissile species. A summary of the identified and possible delayed-neutron precursors in U^{235} fission is given. 2. A table is presented of the photoneutron yield from fission gammas on D_2O, and a new analysis of Be photoneutron data is made which results in a set of nine photoneutron groups. (D.L.C.)

29824 NUCLEAR DATA FOR REACTOR STUDIES. Robert N. MacDonald and H. Hayne Baucom, Jr. (Atomics International, Canoga Park, Calif.). Nucleonics, 20: No. 8, 158-61(Aug. 1962).

Neutron and gamma ray data are tabulated for alloys, compounds, elements $1 < Z < 88$, and selected nuclides. The data reported are the 2200 m/sec macroscopic cross section, total attenuation coefficient for 3-Mev gammas, energy absorption coefficient for 3-Mev gammas, macroscopic removal cross section for 8-Mev neutrons, absorption resonance integral, diffusion length, and diffusion coefficient. (D.L.C.)

29825 RESONANCE INTEGRALS FOR GOLD AND INDIUM FOILS. Charles N. Kelber (Argonne National Lab., Ill.). Nucleonics, 20: No. 8, 162(Aug. 1962).

The resolved resonance integrals of thin Au^{198} and In^{115} foils were calculated with the effects of foil thickness represented by an equivalent volume scattering. Integrals are tabulated for microscopic equivalent volume scatterings of 500 to ∞ barns/absorber atom. Resonance parameters used in the calculations are also tabulated. (D.L.C.)

29826 THE COLLISION OF SLOW ELECTRONS WITH HYDROGEN ATOMS. V. D. Kamenetskii. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 366(May 1962).

A quantum mechanical method using trial wave functions and modified for self-consistency at the boundary was used to calculate the elastic scattering of S-electrons by hydrogen atoms. The results for the phases, cross sections, and trial functions are compared with these obtained by the variational method and numerical integration. It is seen that the new method is as accurate as the variational method and is simpler to use. (D.L.C.)

29827 (γ,p + α) REACTIONS IN ^{12}C, ^{14}N AND ^{16}O. W. T. Morton and T. G. Walker (Univ. of Glasgow). Phil. Mag. (8), 7: 741-4(May 1962).

By irradiating normal and water-loaded nuclear emulsions with a bremsstrahlung beam of peak energy 120 Mev, the cross sections for the reactions $C^{12}(\gamma,p\alpha)Li^7$, $N^{14}(\gamma,p\alpha)Be^9$, and $O^{16}(\gamma,p\alpha)B^{11}$ were found to be 1.9 ± 0.4, 2.5 ± 0.5, and 0.3 ± 0.2 Mev mb respectively. (auth)

29828 DECAY OF Y^{92} AND Nb^{92}. M. E. Bunker, B. J. Dropesky, J. D. Knight, and J. W. Starner (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 844-54(Aug. 1, 1962). (LADC-5293)

The radiations of Y^{92} (3.50 hr) and Nb^{92} (10.1 day) have been studied with the help of scintillation spectrometers and a solenoidal beta spectrometer. Analysis of the experimental results indicates that the Y^{92} decay scheme involves six excited states of Zr^{92}, which have the following energies (Mev), spins, and parities: 0.932 (2+), 1.380 (0+), 1.492 (4+), 1.836 (2+), 2.05 (2+), and 2.33 (3−). The spectrum of the 3.64-Mev beta transition from Y^{92} to the Zr^{92} ground state has a unique first-forbidden shape, identifying Y^{92} as a 2− state. Nb^{92}, which decays only to the 1.836- and 0.932-Mev levels of Zr^{92}, is postulated to have spin and parity 2+. Several features of the level structure of Zr^{92} appear to be manifestations of simple shell-model phenomena. It is proposed that the main components of the 1.380- and 1.836-Mev states are excited proton configurations, whereas the dominant components of the levels at 0.932, 1.492, and 2.05 Mev are excited neutron configurations. (auth)

29829 DECAY OF Sr^{85}. Allan R. Sattler (Pennsylvania State Univ., University Park). Phys. Rev., 127: 854-9 (Aug. 1, 1962).

A gamma ray of 0.878 Mev was found in the decay of Sr^{85} in addition to the well-known 0.514-Mev gamma ray. The half lives of both gamma rays were measured. The half-life of the 0.878-Mev gamma ray was found to be 64.9 ± 1.99 days and the half life of the 0.514-Mev gamma ray was found to be 63.9 ± 0.27 days. There is good evidence of a gamma ray of 0.356 ± 0.015 Mev in coincidence with the 0.514-Mev gamma ray. The 0.878-Mev gamma ray has also been found to be in coincidence with the characteristic x ray of Rb due to orbital electron capture. The relative intensities of the 0.878-, 0.356-, and 0.514-Mev gamma rays are about 1.07×10^{-4}, 0.2×10^{-4}, and 1.0, respectively. A decay scheme is proposed on the basis of these results. (auth)

29830 ENDOTHERMIC DEUTERON STRIPPING REACTIONS. III. THE $C^{14}(d,p\gamma)C^{15}$ AND $Li^7(d,p\gamma)Li^8$ REACTIONS. L. F. Chase, Jr., R. G. Johnson, F. J. Vaughn, and E. K. Warburton (Lockheed Missiles and Space Research Lab., Palo Alto, Calif.). Phys. Rev., 127: 859-66(Aug. 1, 1962).

The cross section of the $C^{14}(d,p)C^{15*}$ reaction (Q = −1.76 Mev) to the first excited state of C^{15} at 0.75 Mev was measured for deuteron energies between 2.7 and 3.4 Mev. The cross section was obtained from the yield of the γ ray to the C^{15} ground state. The energy of this γ ray was measured to be 0.750 ± 0.007 Mev. The γ-ray angular distribution relative to the deuteron beam was measured at five deuteron energies between 2.9 and 3.4 Mev. The presence of a $P_4(\cos\theta)$ term in the distributions together with previous work establishes the C^{15} 0.75-Mev level as $\frac{5}{2}^+$. The measured angular distributions were found to be in agree-

ment with predictions based on stripping theory. The cross section for the $Li^7(d,p)Li^{8*}$ reaction (Q = −1.17 Mev) to the first excited state of Li^8 at 0.98 Mev was measured for deuteron energies between 1.9 and 3.3 Mev. The cross section was obtained from the yield of the γ ray to the Li^8 ground state. The γ-ray energy was measured to be 0.980 ± 0.010 Mev. The anisotropy of this γ ray was measured at 23 deuteron energies between 1.9 and 3.3 Mev. These results were also consistent with the predictions of stripping theory if assignments of 1^+ for the Li^8 0.98-Mev level and M1 for the 0.98-Mev γ ray are assumed. (auth)

29831 GAMMA-RAY EMISSION FROM COMPOUND NUCLEUS REACTIONS OF HELIUM AND CARBON IONS. James F. Mollenauer (Univ. of California, Berkeley and Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 867-79(Aug. 1, 1962). (BNL-5922)

The assumption that gamma emission does not occur in compound nucleus reactions until the excitation energy falls below the particle emission threshold was tested by direct observation of the gamma rays. Bombardments of Ba, Ho, Co, and Ta targets were carried out with helium ions; Te and V were bombarded with C^{12} ions. For the carbon ion reactions, in which the average angular momentum induced by the projectile ranged from 17 ħ to 38 ħ, the total energy release in gamma rays exceeded the neutron binding energy, in contradiction to the assumption. This was not so for any alpha-particle reaction. A comparison of the gamma yields for the same compound nucleus, as produced by alpha particles and carbon ions at the same excitation energy, indicates that the enhancement is an angular momentum effect, independent of excitation energy. The magnitude of the gamma yield enhancement is in agreement with observed displacements of heavy ion excitation functions to higher bombarding energy. The gamma yield was measured at 45 and 90° to the beam direction. Both the helium ion bombardments at 45 Mev and carbon ions incident on V^{51} at comparable energy produced large anisotropies in the gamma-ray emission, with maxima in the direction required by quadrupole transitions. The photon emission was more nearly isotropic for alpha bombardments at 28 Mev and for C^{12} on Te at 115 Mev. The average photon energy ranged from 1.0 to 1.6 Mev. These observations are consistent with gamma emission in collective transitions and are inconsistent with a statistical model of the deexcitation process, which predicts dipole emission, small anisotropy, and an average gamma energy twice that observed. The lack of quadrupole anisotropy for the Te target may result from a high-spin limit to the collective motion. The energy spectra suggest that the collective transitions may be vibrational, with rotational transitions occurring mainly in nuclei deformed in the ground state. Except for compound nuclei of A ~60, good agreement was obtained between the observed anisotropy and a model based on a gamma cascade through levels of specified rather than randomly chosen spin. (auth)

29832 NEUTRON YIELDS FROM INDIVIDUAL FISSION FRAGMENTS. James Terrell (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 880-904(Aug. 1, 1962). (LADC-5335)

Two new methods are used to obtain data on neutron yield ν_f as a function of the mass number M of the emitting fission fragment; the results suggest changes in fission theory. The methods involve the combination of data on fission mass yields obtained by radiochemical means with time-of-flight mass data. The more detailed method yields essentially the complete function $\nu_f(M)$. Both methods are applied to neutron fission of U^{233}, U^{235}, and Pu^{239}, and to spontaneous fission of Cf^{252}. The neutron yields obtained, which show strong variation with mass, are compared with other available data; no previous results exist for Pu^{239}. The four sets of data on $\nu_f(M)$ are so similar that it is suggested that the neutron yield is primarily a function of fragment mass and not of mass ratio. In each case minimum neutron yield is found for N ≅ 50 and Z = ≅ 50 (masses 82 and 128). It is suggested that these magic and near-magic fragments have low excitations, and consequently emit almost no neutrons, because of greater rigidity against distortion from near-spherical shapes. The same idea leads to a prediction of high fission barrier and low fission yield at these masses, which compares well with data for single-peaked, triple-peaked, and ordinary double-peaked-mass-yield fission. In the appendices a number of necessary relations are developed, concerning neutron emission energies. The width of the neutron emission spectrum is deduced from laboratory spectra; new relations between emission spectra and angular correlation of neutrons and fragments are developed and applied; and it is shown that the extra width of fragment mass yields obtained from fragment energies (semiconductor or ionization-chamber data) is due to the correlation of ν_f and M. (auth)

29833 ALPHA DECAY OF NONAXIAL NUCLEI. A. K. Rafiqullah (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev., 127: 905-13(Aug. 1, 1962).

A theory is developed, within the context of the Davydov-Filippov model of the nucleus, to describe the even-parity alpha decay of nonaxial nuclei. The wave equation of the system consisting of a daughter nucleus and an alpha particle is solved under the boundary conditions that on the nuclear surface the wave function shall be equal to a given function and that the function shall represent only an outgoing wave for large values of r. It is found that if the given function is assumed to be equal to a constant, the observed variations of the alpha transition probabilities with respect to Z in even-even nuclei cannot be explained. But if one assumes that this given function can be represented as an expansion in spherical harmonics, keeping only quadrupole terms, the expansion coefficients being determined by the empirical data (that is, setting the boundary conditions by the empirical data), the observed variations can be theoretically reproduced. Even-parity alpha transitions in odd-A nuclei are also considered. The comparison between theory and the empirical data is quite satisfactory. (auth)

29834 GAMMA DECAY OF THE 7.57-Mev LEVEL OF N^{15}. W. W. Eidson and R. D. Bent (Indiana Univ., Bloomington). Phys. Rev., 127: 913-16(Aug. 1, 1962).

The $C^{12}(\alpha,p\gamma)N^{15}$ reaction was studied using particle-gamma coincidence techniques and the 22-Mev alpha-particle beam of the Indiana University cyclotron. The 7.57-Mev level of N^{15} is observed to decay by gamma emission to either the 5.28- or 5.30-Mev level. An upper limit of 10% is placed on the intensity of the ground-state branch. This information, together with the results of other experiments, suggests a spin and parity assignment of $\frac{5}{2}^+$ or $\frac{7}{2}^+$ for the 7.57-Mev level, which is consistent with shell-model predictions. (auth)

29835 ISOMERIC STATE OF Po^{212}. I. Perlman, F. Asaro, A. Ghiorso, A. Larsh, and R. Latimer (Univ. of California, Berkeley). Phys. Rev., 127: 917-22(Aug. 1, 1962). (UCRL-10094)

An isomer of Po^{212} with a half life of (45.1 ± 0.6) sec and an excitation energy of 2.93 Mev has been positively identified by chemical and nuclear spectroscopic techniques. The isomer decays to known states of Pb^{208} by the emission of alpha particles with energies and intensities of (11.65 ±

0.02) Mev–97%, (9.08 ± 0.015) Mev–(1.00 ± 0.04)%, and (8.52 ± 0.015) Mev–(2.05 ± 0.09)%. In coincidence with Po^{212m} alpha particles, gamma rays with energies and intensities of (2.61 ± 0.02) Mev–(2.6 ± 0.3)% and (0.57 ± 0.015) Mev–~2% were found. An immense alpha-decay hindrance factor for the 11.65-Mev group of 4×10^{13} is explained by spin and parity assignments of 18+ for Po^{212m} in conjunction with a theoretical shell-model analysis made by Glendenning. The alpha-particle energies and intensities of previously known alpha groups of Po^{211m} [(25.5 ± 0.3) sec] were measured yielding values of (8.87 ± 0.01) Mev–(7.04 ± 0.14)%, (7.99 ± 0.015) Mev–(1.66 ± 0.03)%, and (7.27 ± 0.015) Mev–91%. A new alpha group was found with an energy and intensity of (8.30 ± 0.015) Mev–(0.25 ± 0.02)%. In coincidence with Po^{211m} alpha particles was a gamma ray of (0.90 ± 0.015) Mev–(1.65 ± 0.11)%. These Po^{211m} radiations are all consistent with the known energy level scheme of Pb^{207}. (auth)

29836 NOTE ON AN ISOMERIC STATE OF Po^{212}. Norman K. Glendenning (Univ. of California, Berkeley). Phys. Rev., 127: 923-5(Aug. 1, 1962). (UCRL-10095)

A shell-model calculation for Po^{212} involving the four nucleons outside the Pb^{208} core was performed to show how the shell model can account for a recently discovered high-spin isomer of Po^{212}. (auth)

29837 POLARIZATION OF PROTONS IN $Be^9(d,p)Be^{10}$. J. A. Green and W. C. Parkinson (Univ. of Michigan, Ann Arbor). Phys. Rev., 127: 926-8(Aug. 1, 1962).

Measurements of the angular dependence of the polarization in the $Be^9(d,p)Be^{10}$ reaction are described. The results, together with the (d,pγ) angular correlation measurements at the same energy, indicate that spin-dependent calculations are required to fit the data. (auth)

29838 GYROMAGNETIC RATIOS OF THE 2^+ STATES IN EVEN TUNGSTEN ISOTOPES. G. Goldring and Z. Vager (Weizmann Inst. of Science, Rehovoth, Israel). Phys. Rev., 127: 929-40(Aug. 1, 1962).

Precession measurements of gyromagnetic ratios have been carried out for the 2^+ states in even tungsten isotopes. The nuclei were excited by Coulomb excitation with a neutral atomic-hydrogen beam and the time-integrated rotation of the angular distribution of the de-excitation gamma rays in an applied magnetic field was measured. The targets were in metal form and the angular distributions were found to be almost unperturbed. The measured gyromagnetic ratios are: $g(W^{182}) = 0.193 \pm 0.018$, $g(W^{184}) = 0.207 \pm 0.016$, and $g(W^{186}) = 0.292 \pm 0.027$. The values obtained for W^{182} and W^{184} are in disagreement with some previous measurements. (auth)

29839 EXCITATION OF TWO-PHONON STATES BY INELASTIC α-PARTICLE SCATTERING. B. Buck (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 940-2 (Aug. 1, 1962).

Recent experiments on inelastic scattering of 40-Mev α particles have shown that the angular distributions from the excitation of some known 4^+ states in medium weight nuclei are not in accord with the Blair phase rule. Calculations are reported which indicate that the anomaly arises as an interference effect between two possible mechanisms for exciting the first 4^+ state, i.e., a direct transition and a multiple transition. This conclusion is contrary to previous interpretations based on plane-wave perturbation calculations. It is suggested that experiments of this type, and the analysis given, promise to be a useful tool for the study of higher excited states. (auth)

29840 Pm^{145}: A NEW ALPHA ACTIVITY. M. Nurmia, P. Kauranen, and A. Siivola (Univ. of Helsinki, Finland). Phys. Rev., 127: 943-4(Aug. 1, 1962).

Pm^{145} was prepared by means of the chain $Sm^{144}(n,\gamma) \times Sm^{145} \xrightarrow{E.C.} Pm^{145}$. The alpha activity of Pm^{145} was studied by means of a gridded ionization chamber and a 512-channel pulse-height analyzer. The alpha energy was found to be 2.24 ± 0.04 Mev, and the branching $(2.8 \pm 0.6) \times 10^{-5}$ alphas per disintegration. With a view to proving that the alpha activity was not due to Sm^{147}, a further Sm-Pm separation was carried out with no detectable change in the branching ratio. The thermal neutron capture cross sections of Sm^{146} and Sm^{145} were estimated to be 0.7 and 110 b. (auth)

29841 PHOTODISINTEGRATION OF HELIUM. Paul Goldhammer and Henry S. Vaulk (Univ. of Nebraska, Lincoln). Phys. Rev., 127: 945-6(Aug. 1, 1962).

The integrated electric dipole absorption cross section σ_{int} and bremsstrahlung-weighted cross section σ_b are calculated for He^4. By using a two-body interaction operator having a Serber exchange character with a repulsive core and tensor component, it is found that $\sigma_{int} = 107$ Mev-mb and $\sigma_b = 2.73$ mb, in reasonable agreement with the current experimental values: $\sigma_{int} = 95 \pm 7$ Mev-mb and $\sigma_b = 2.4 \pm 0.15$ mb. (auth)

29842 SPALLATION OF ALUMINUM BY 28-Gev PROTONS. J. B. Cumming, G. Friedlander, J. Hudis, and A. M. Poskanzer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 950-4(Aug. 1, 1962). (BNL-6034)

In the bombardment of Al foils with 28-Bev protons the following cross sections (in mb) for production of the indicated nuclides were obtained: Be^7, 7.9 ± 0.5; F^{18}, 6.0 ± 0.3; C^{11}, 4.7 ± 0.2; Na^{22}, 9.8 ± 0.6; N^{13}, 1.18 ± 0.07; Na^{24}, 8.3 ± 0.5; O^{15}, 3.5 ± 1.0; Mg^{27}, 0.067 ± 0.006. An upper limit for the Ne^{24} cross section of 0.6 mb was obtained. The Mg^{27} cross section has been corrected for secondary reactions and represents only production by primary protons, presumably by the $(p,p\pi^+)$ reaction. The measurements were made relative to the production of C^{11} activity in polyethylene and polystyrene foils. The production of Be^7 in the plastic foils was also observed and corresponds to a cross section of 7.7 ± 0.4 mb per carbon nucleus. By comparison of these cross sections with those at lower bombarding energies, no significant trend of the excitation functions is observable. (auth)

29843 ELASTIC SCATTERING OF HEAVY IONS BY Pb^{206}, Pb^{207}, AND Pb^{208}. D. D. Kerlee (Seattle Pacific Coll. Inst. for Research), H. L. Reynolds, and E. Goldberg. Phys. Rev., 127: 1224-9(Aug. 15, 1962).

The angular distributions of C^{12}, N^{14}, O^{16}, and Ne^{20} elastically scattered by Pb^{206}, Pb^{207}, and Pb^{208} have been measured at laboratory energies of approximately 10.4 Mev/nucleon. The elastically scattered ions were recorded in photographic emulsions at laboratory angles from 17° to 175°. In general, measurements were extended only to angles where the ratio of the cross section to the Coulomb cross section, σ/σ_c, was greater than 0.2. In one case, the measurement was extended to a region where $\sigma/\sigma_c \leq 1.2 \times 10^{-3}$. The cross sections all exhibited a behavior similar to that previously reported for the same ions on Au^{197} and Bi^{209}. Excellent agreement with the semiclassical strong absorption model was obtained. Nuclear interaction distances calculated by fitting the strong absorption calculations are consistent with $r_0 = 1.45$ F, where $R = r_0(A_1^{1/3} + A_2^{1/3})$. (auth)

29844 MEASUREMENT OF THE $O^{16}(n,p)N^{16}$ CROSS SECTION FROM 11 TO 19 Mev. J. A. DeJuren (Westinghouse Electric Corp., Pittsburgh), R. W. Stooksberry and M. Wallis. Phys. Rev., 127: 1229-32(Aug. 15, 1962). (WAPD-T-1381)

The experiment was undertaken to improve upon the

accuracy and energy resolution of the $O^{16}(n,p)N^{16}$ cross section and to extend the neutron energy range covered. The oxygen was contained in a dioxane liquid scintillator which was irradiated by accelerator-produced neutrons. Shaped holders were used at appropriate angles from the target to obtain good energy resolution for neutrons produced by both $T(d,n)He^4$ and $D(t,n)He^4$ reactions. After the irradiation the scintillator was automatically transferred to a 4π β-counting system. The resulting cross section data exhibit a previously undetermined resonance near 11.8 Mev. Integration of the experimental cross sections over U^{235} fission spectrum formulations yield values of 16 to 19 μb per neutron. (auth)

29845 EXPERIMENTAL STUDY AND DISTORTED-WAVE PREDICTIONS FOR THE (He^3,α) REACTION ON Fe ISOTOPES. A. G. Blair and H. E. Wegner (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 1233-45(Aug. 15, 1962). (LADC-5153)

Angular distributions of some alpha-particle groups from the (He^3,α) reaction on Fe^{54}, Fe^{56}, Fe^{57}, and Fe^{58} have been obtained experimentally. The He^3 beam energy was about 14.3 Mev except that data were also obtained for the Fe^{57} target with a beam energy of 24.9 Mev. Angular distributions were also obtained for He^3 and alpha particles elastically scattered from Fe^{56}. For the (He^3,α) reaction, groups corresponding to $l = 3$ neutron transfers were peaked strongly forward, while groups corresponding to $l = 1$ neutron transfers were not but showed much more diffraction structure. The cross sections for the strong $l = 3$ groups were very much larger than those for the strongest of the $l \neq 1$ groups. This ratio is in distinct contrast to the results of (d,t) and (p,d) experiments on the same isotopes. In addition, the $Fe^{57}(He^3,\alpha)$ reaction to the ground and first-excited states of Fe^{56} proceeded with a cross section lower by more than an order of magnitude than that expected on the basis of data from the (d,t) and (p,d) reactions. The (He^3,α) reaction cannot be satisfactorily analyzed with the plane-wave Butler-Born calculation. In contrast, the distorted-wave Born-approximation calculation predicts curves which are usually in good agreement with the experimental angular distributions, and yields ratios of spectroscopic factors which are in fair to good agreement with the results of a plane-wave analysis of the (d,t) data and in fair agreement with the results of a distorted-wave analysis of the (p,d) data. The parameter values used in the distorted-wave calculation for the (He^3,α) reaction on Fe^{54}, Fe^{56}, and Fe^{58} were very nearly those which yielded the best optical-model fits to the Fe^{54} elastic scattering data. The distorted-wave calculation for the $Fe^{57}(He^3,\alpha)Fe^{56}$ reaction required somewhat different parameter values. (auth)

29846 EXCITATION FUNCTION OF THE $Al^{27}(d,p)Al^{28}$ REACTION BETWEEN 2.2 AND 12.6 Mev. Jorge Merlo Flores (Comisión Nacional de Energía Atómica, Buenos Aires). Phys. Rev., 127: 1246-7(Aug. 15, 1962).

The excitation function of the $Al^{27}(d,p)Al^{28}$ reaction has been measured using the stacked-foil technique between 2.2 and 12.6 Mev. The absolute calibration was done by measuring simultaneously the excitation function of the (d,p) and the $(d,\alpha p)$ reactions on Al^{27}, and comparing the results of the $(d,\alpha p)$ reaction with those of Batzel et al. The peak value of the excitation function was found to be located between 7 and 8 Mev, with a value of 239 ± 29 mb. The half life of the Al^{28} was measured, giving a value of 2.28 ± 0.06 min. The deuteron beam used was that of the Buenos Aires synchrocyclotron. (auth)

29847 FISSION FRAGMENT ANGULAR DISTRIBUTIONS BY EXACT POWER SERIES. James J. Griffin (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 1248-52 (Aug. 15, 1962).

A method is illustrated for computing exactly the various terms of the power series for fission fragment angular distributions. No semiclassical approximation to the wave functions is made. The results are therefore accurate even for small angular momenta. The angular distributions are calculated explicitly to second order, including perturbative effects of spin and of angular-momentum-dependent fissionability. Results are compared with exact numerical calculations to illustrate the adequacy of the first- and second-order approximations under various circumstances. (auth)

29848 POLARIZATION OF PROTONS IN $Be^9(d,p)Be^{10}$. R. G. Alias, R. W. Bercaw, and F. B. Shull (Washington Univ., St. Louis). Phys. Rev., 127: 1252-7(Aug. 15, 1962).

The polarization of protons from the $Be^9(d,p)Be^{10}$ reaction has been measured at an incident deuteron energy of 10 Mev. The measurement has been carried from 13°(lab) to 80°(lab). The polarization is positive at forward angles but changes sign at about 70°(lab). Elastic scattering of protons from helium and carbon was used as the analyzing reaction. The axis of quantization is taken as $n = k_d \times k_p$. (auth)

29849 DECAY OF Ag^{103}. A. P. Patro and B. Basu (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., 127: 1258-61(Aug. 15, 1962).

The nucleus Ag^{103} has been studied with scintillation beta and gamma spectrometers. The isotope was produced by a (p,γ) reaction on Pd^{102} with low-energy protons (~3 Mev) to exclude production of Ag^{104}. In addition to the gamma rays already reported in the literature, prominent gamma rays at 1010 kev, 1160 kev, and 1280 kev have been observed. A new positron group of 1.57-Mev end-point energy has also been observed. Beta-gamma coincidences, gamma-gamma coincidences, and sum studies have been made, and on the basis of those measurements a level scheme of Pd^{103} is proposed. (auth)

29850 DECAY MEASUREMENTS OF Ba^{141} AND Ba^{142}. K. Fritze and T. J. Kennett (McMaster Univ., Hamilton, Ont.). Phys. Rev., 127: 1262-8(Aug. 15, 1962).

The decay properties of the fission products Ba^{141} and Ba^{142} have been studied with scintillation techniques. Using a new method, Ba^{141} was obtained free of Ba^{142}. The following γ-ray energies (and relative intensities) were found for Ba^{141}: 118 (0.7), 193 (10), 276 (5), 307 (6), 348 (2), 460 (3), 640 (2), 730 (0.7), 860 (0.6), 930 (0.3), 1190 (0.8), 1290 (0.3), 1420 (0.4), and 1650 (0.3) kev. The γ rays at 460 and 640 kev are doublets. From single-crystal β-ray measurements and from β- and γ-ray coincidence experiments, the Q_β value was found to be 3.0 ± 0.1 Mev. There is a weak ground-state transition; the first strong β-ray group ends at 2.84 ± 0.1 Mev. The combination of all results suggests the following energy levels in La^{141}: 193, 307, 470, 650, 930, 1100, 1190, 1290, 1420, and 1650 kev. The decay of Ba^{142} was studied using mixtures of Ba^{141} and Ba^{142}. The following γ rays (and relative intensities) were found to be associated with the decay of Ba^{142}: 80 (4.5), 135 (2.0), 227 (5.3), 255 (10), 365 (1.3), 425 (2.5), 625 (1.8), 690 (0.9), 905 (4.0), 1070 (2.0), 1180 (5.5), and 1360 (1.2) kev. The Q_β value is 2.2 ± 0.1 Mev and the strongest β-ray end point lies in the range 1.65 to 1.85 Mev. The half lives of Ba^{139}, Ba^{141}, Ba^{142}, La^{141}, and La^{142} have been determined and found to be 82.9 ± 0.2 min, 18 ± 1 min, 11 ± 1 min, 3.90 ± 0.05 hr, and 92.5 ± 0.5 min, respectively. (auth)

29851 (p,Be^7) REACTION IN Al AND Mg FROM 27 TO 31.5 Mev. Richard H. Lindsay (Western Washington State

Coll., Bellingham) and Edward F. Neuzil. Phys. Rev., 127: 1269-73(Aug. 15, 1962).

A study has been made of the cross sections for the $Al^{27}(p,Be^7)$ and the $Mg(p,Be^7)$ reactions in the energy range 27 to 31.5 Mev. The $Al^{27}(p,Be^7)$ data are contrasted with the known $Mg^{24}(He^4Be^7)$ reaction cross sections using 30- to 42-Mev He ions, both of which lead to the same compound nucleus. It is seen that the reactions proceed chiefly by a compound nuclear mechanism in this energy range. A three-nucleon transfer direct-interaction mechanism is a possible contributor to the He-ion-induced reaction. (auth)

29852 PHOTONEUTRON CROSS-SECTION MEASUREMENTS ON GOLD USING NEARLY MONOCHROMATIC PHOTONS. S. C. Fultz, R. L. Bramblett, J. T. Caldwell, and N. A. Kerr (Univ. of California, Livermore). Phys. Rev., 127: 1273-9(Aug. 15, 1962). (UCRL-6681)

Continuously variable monochromatic gamma rays with an energy spread of 3% have been produced using the annihilation in flight of positrons accelerated in a linear electron accelerator. These gamma rays have been employed to measure the (γ,n) and $(\gamma,2n)$ cross sections for gold. A neutron counting method was used to determine the neutron multiplicity. The photoneutron yield for Au has a maximum of 535 ± 37 mb at 13.7 ± 0.3 Mev. The $(\gamma,2n)$ cross section was observed to have a threshold at 14.5 ± 0.5 Mev and a maximum of approximately 100 mb at 18 Mev. The integrated (γ,n) and $(\gamma,2n)$ cross sections, up to 25 Mev, were found to be 2.14 ± 0.15 and 0.83 ± 0.16 Mev-b, respectively. The value of $\int_0^\infty \sigma E^{-2} dE$ was determined to be 15.3 ± 1.5 mb/Mev. The level density parameter α was found to be 17.1 ± 0.5 Mev^{-1}. The total cross section $\sigma(\gamma,n) + \sigma(\gamma,2n) + \sigma(\gamma,pn)$ can be fitted with a single Lorentz curve having a peak cross section of 535 mb at 13.90 Mev and a width of 4.2 Mev. (auth)

29853 RADIATIVE CAPTURE OF N^{14} ON P^{31}. B. Linder (Florida State Univ., Tallahassee) and A. Zucker. Phys. Rev., 127: 1280-3(Aug. 15, 1962).

The cross section for radiative capture of N^{14} on P^{31}, $P^{31}(N^{14},\gamma)Ti^{45}$, was measured at 27-Mev incident nitrogen energy, by separating chemically and identifying the radionuclide Ti^{45}. The cross section was found to be 1 μb within the estimated error of about a factor of 2. This result is compared with the prediction of a statistical model and found to be in reasonable agreement with theory. (auth)

29854 NUCLEAR STRUCTURE STUDIES IN THE LEAD REGION WITH STRIPPING REACTIONS. Paresh Mukherjee and Bernard L. Cohen (Univ. of Pittsburgh). Phys. Rev., 127: 1284-96(Aug. 15, 1962).

The seven single-particle neutron states in the $126 < N \leq 184$ shell are located and identified with the $Pb^{208}(d,p)Pb^{209}$ reaction. The missing $h_{\frac{9}{2}}$ hole state in Pb^{207} is also located and identified with (d,t) reactions. Nuclei with two particles and holes, such as Pb^{206}, Pb^{208} (excited), Bi^{208}, and Bi^{210}, are studied; their level structure can be qualitatively and sometimes even semi-quantitatively understood by considering two-particle couplings using the known particle and hole states. The ground-state wave function of Pb^{208} is studied by three independent methods; all agree that that it is only about 54% $(p_{\frac{1}{2}})^{-2}$ rather than 73% as given by shell-model calculations. The three-neutron spectra of Pb^{205} and Pb^{207} (excited) are studied, and the principal features can be understood as couplings of one particle or hole to the ground state and other low-lying states of Pb^{206}. Some preliminary evidence is obtained on the $N > 184$ shell. (auth)

29855 NONSINGULAR FORMULATION OF THE BRUECKNER APPROXIMATION FOR AN INFINITE FERMI SYSTEM. Richard L. Becker (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 1328-42(Aug. 15, 1962).

In the approximation neglecting any but single pair correlations, singularities of the reaction matrix render Brueckner's integral for the average energy per particle a singular integral. Several attempts to overcome this difficulty have been unsuccessful. By considering the infinite Fermi system to be a limit of finite systems, it is shown that the correct result merely involves replacing Brueckner's ordinary integral over diagonal reaction matrix elements by a principal value integral. In a finite system the level shift of a Bethe-Goldstone state differs from the diagonal reaction matrix element by a normalization factor which does not approach unity uniformly in the integration variable as the volume becomes infinite. In the neighborhood of a singularity the expression for the two-particle energy shift takes the form $cy/(y^2 + cV^{-1})$, where y is the unperturbed energy measured from the singularity, c is the square of a matrix element, and V is the quantization volume. Hence as $V \to \infty$ the sum over the energy y indeed approaches a principal value integral. An alternative derivation, employing a modified reaction matrix for which there is no difference between level shift and matrix element, leads to the same result. The general derivations are preceded by a soluble example. The connection of the Brueckner approximation with a phase-shift approximation for low-density systems is discussed. Some corrections to the higher order terms in existing derivations of the "separation method" expansion of the Brueckner reaction matrix are given. (auth)

29856 NUCLEAR RESONANCE MEASUREMENTS WITH THE HELP OF POLARIZED NEUTRONS. A. H. Wapstra (Instituut voor Kernfysisch Onderzoek, Amsterdam). Ned. Tijdschr. Natuurk., 26: 101-8(Apr. 1960). (In Dutch)

The experimental study on the measurement of nuclear resonance with polarized neutrons is reviewed. A typical setup for such measurements is shown graphically. The results obtained from measurements of Li^7 in LiF crystals are discussed to show the asymmetry of the β particles. Similar results are shown for F^{20} in CaF_2. (J.S.R.)

29857 SOME NEW INSIGHTS ON THE THEORY OF NUCLEAR FISSION. A. van der Woude (Natuurkundig Laboratorium, Groningen, Netherlands). Ned. Tijdschr. Natuurk., 26: 317-22(Oct. 1960). (In Dutch)

Experimental developments which in recent years have shown the deficiencies of the liquid drop model in the explanation of nuclear fission are summarized. The angular and mass distributions in the fission products are considered with respect to the collective model. The effect of individual particles on spontaneous fission is shown. (J.S.R.)

29858 DETERMINATION OF THE BASIC CHARACTERISTICS OF PHOTONUCLEAR REACTIONS FOR A NUMBER OF CHEMICAL ELEMENTS AND THE POSSIBILITIES OF THEIR PRACTICAL APPLICATION. I. A. Grishayev, A. M. Parlag, D. I. Sikora, V. A. Shkodo-Ulyanov, and B. I. Shramenko. Ukrain. Fiz. Zhur., 7: 138-44(1962). (In Ukrainian)

The basic difficulties of measuring cross sections of photoneutron formation are discussed in this paper. The use of thick targets for a number of chemical elements simplifies the problem of obtaining excitation functions and reduces the errors connected with their determination. A method for defining the water-oil contact line in geological prospecting by comparing the photoneutron emission from water and oil is proposed as a practical application of the method of thick targets. (auth)

29859 DETERMINATION OF PARAMAGNETIC RESONANCE FREQUENCY RATIO OF LITHIUM NUCLEI AND PROTONS. G. K. Yagola and E. E. Bogatyryov. Ukrain. Fiz. Zhur., 7: 145-7(1962). (In Ukrainian)

A simple method is described for measuring the paramagnetic resonance frequency ratio of lithium nuclei and protons. A value of $f^{T}_{Li}/f_{p} = 0.3886357 \pm 0.0000016$ in an aqueous solution of LiCl and 0.15M $FeCl_3$ was obtained. (auth)

29860 EXPERIMENTAL INVESTIGATION AND THEORETICAL CONSIDERATION OF THE (n,α) AND $(n,n\alpha)$ REACTIONS IN THE SCINTILLATION CRYSTALS KI(Tl) AND CsI(Tl) FOR NEUTRON ENERGIES OF 12.1 TO 21.5 Mev. M. Bormann (Physikalischen Staatsinstitut, I. Institut für Experimentalphysik, Hamburg). Z. Naturforsch., 17a: 479-93(June 1962). (In German)

Investigations of the (n,α) and $(n,n\alpha)$ reactions which were initiated by neutrons with energies between 12.1 and 21.5 Mev in the scintillation crystals KI(Tl) and CsI(Tl) are reported. The experimental method used utilizes the fact that with the help of these crystals a distinction between different types of incident particles could be made. This possibility was drawn upon to register the energy distribution of the α particles which were emitted in the bombardment of the crystals with neutrons of the given energy range in the (n,α) and $(n,n\alpha)$ reactions on the elements of the scintillators. The effective cross sections for these reactions were also determined as a function of the neutron energy. The measurement results were analyzed on the basis of the statistical theory of nuclear reactions by application of different level density expressions and cross sections for formation of the compound nucleus. As a result, it was shown that the (n,α) reaction on potassium can be explained as an evaporation process, whereas in the case of iodine and cesium, significant contributions occur from direct interaction processes in addition to the evaporation fraction. The contribution of the direct processes to the α spectra is discussed. (tr-auth)

29861 HYPERFINE STRUCTURE OF THE 14.4-kev STATE OF Fe^{57}, COMBINED IN VARIOUS IRON CARBONYLS. M. Kalvius, U. Zahn, P. Kienle, and H. Eicher (Technische Hochschule, Munich and Universität, Munich). Z. Naturforsch., 17a: 494-9(June 1962). (In German)

The Mössbauer spectra of the 14.4 kev γ ray of Fe^{57} in iron carbonyls were investigated. The data reveal the existence of electric field gradients at the Fe^{57} nuclei, produced by the electrons in the molecular orbitals of the compounds. Various aspects of the molecular structure and bond could be deduced from the magnitude of the observed quadrupole splitting. The Mössbauer spectra indicate a preferred orientation of the molecules in solid $Fe(CO)_5$. The sign of quadrupole moment of the 14.4-kev level of Fe^{57} is found to be positive from these data. (auth)

29862 EFFECT OF THE FINITELY EXPANDED NUCLEUS IN INELASTIC ELECTRON AND POSITRON SCATTERING ON ATOMIC NUCLEI. Rudolf Rodenberg (Universität, Tubingen, Ger.). Z. Naturforsch., 17a: 537-8 (June 1962). (In German)

In earlier work the total or differential cross sections for inelastic electron and positron scattering were derived. The matrix elements $\mathfrak{M}_{21}(W)$ for the (e,e') process were given analogous to the theory of conversion coefficients where the nuclear coordinates r_n were integrated only from 0 to R ($R = R_0 A^{1/3}$). In the ratio of the cross sections $\mathfrak{F}^{\gamma}(E_1,W)$ for the (e,e') to the (γ,e') process, the magnitude $\rho(L,\tau)$ dependent on the finitely expanded nucleus approached the electron matrix element. In the present work, the supplement to $\rho(L,\tau)$ was given when one must extend the integration range from $R \leq r_n \leq \infty$. (J.S.R.)

29863 THE ROTATION-VIBRATION INTERACTION IN DEFORMED gg NUCLEI. Amand Faessler and Walter Greiner (Universität, Freiburg i. B.). Z. Physik, 168: 425-64 (1962). (In German)

For even-even nuclei a theory of rotation-vibration interaction is established. The basic point is the axial-symmetric intrinsic core of the Bohr-Mottelson theory. It is the aim, just as in the Davydov-Fillipov theory of the asymmetric rotator, to calculate the E 2 transition probabilities from the first γ band to the groundband and to compare the results with experiments. The agreement between theory and experiment is good. (auth)

29864 PRODUCTION OF LIGHT NUCLEI BY BOMBARDING HEAVY ELEMENTS WITH 660 Mev PROTONS. A. K. Lavrukhina, L. P. Moskaleva, V. V. Malyshev, and L. M. Satarova (Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 3-7(July 1962). (In Russian)

The cross sections for production of Be^{7}, Fe^{18}, Na^{24}, Mg^{28}, Si^{31}, and P^{32} from Al, Cu, Sb, Sn, Bi, and U by 660-Mev proton bombardment are studied. For all target nuclei $\sigma(Na^{24}) > \sigma(F^{18})$. The data on the cross sections for light nuclei production indicates that the production of the heavy fragments Si^{31} and P^{32} from copper and neighboring elements occurs as a result of spallation and symmetric fission. Formation of lighter isotopes from all target nuclei occurs via fission and fragmentation. The relative contributions of the indicated processes for Na^{24} nuclei from Cu are estimated on basis of their angular and energy distributions. Na^{24} nuclei with energies exceeding that of Coulomb repulsion are detected in the front hemisphere. The experimental cross sections are compared with some consequences of the dispersion theory of direct nuclear reactions. (auth)

29865 INVESTIGATION OF STRIPPING AND ELASTIC SCATTERING OF DEUTERONS ON THE C^{12} NUCLEUS. K. I. Zherebtsova, V. F. Litvin, and Yu. A. Nemilov. Zhur. Eksptl'. i Teoret. Fiz., 43: 8-10(July 1962). (In Russian)

The angular distributions of elastically scattered deuterons, and protons from the $C^{12}(d,p)C^{13}$ reaction involving the formation of C^{13} in the ground and first excited states, are simultaneously measured with a multi-angle magnetic analyzer. The experimental results are compared with a theory in which strong spin-orbit interaction between the incident and emitted particles is taken into account. (auth)

29866 INVESTIGATION OF THE NUCLEAR REACTION $_{90}Th^{232}(_{10}Ne^{22},4n)_{100}Fm^{250}$. E. D. Donets, V. A. Karnaukhov, G. Kumpf, B. A. Gvozdev, and Yu. T. Chuburkov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 11-15(July 1962). (In Russian)

The dependence of the $Th^{232}(Ne^{22},4n)Fm^{250}$ reaction cross section on the Ne^{22} ion energy is measured. The curve is found to have a peak near 107 Mev (laboratory system) and a half width ~11 Mev. The maximum value of the cross section is $\sim 2.5 \times 10^{-31}$ cm^2. The cross section of the investigated reaction is compared with those for $Pu^{241}(C^{13},4n)Fm^{250}$ and $U^{238}(O^{16},4n)Fm^{250}$. (auth)

29867 PHOTODISINTEGRATION OF OXYGEN. A. N. Gorbunov and V. A. Osipova (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 43: 40-50(July 1962). (In Russian)

The effective cross sections and angular distributions for (γ,p) and (γ,n) reactions on oxygen are measured with

a cloud chamber in a magnetic field. The integral photon absorption cross section is determined in the giant resonance region and up to 170 Mev. An asymmetry in the forward direction is found in the neutron angular distribution for the (γ,n) reaction. The results indicate that nucleon correlations in the nucleus play a significant role. (auth)

29868 ANGULAR DISTRIBUTION OF α-PARTICLES FROM THE $Li^7(p,\alpha)He^4$ REACTION. A. M. Petrov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 43: 66-9(July 1962). (In Russian)

Experimental curves of the relative yield of α particles as a function of the square of the cosine of the emission angle in the cms is given for proton energies from 1.12 to 3.58 Mev. The dependence on proton energy of coefficients of the formula that describes the α particle angular distribution is presented. One of the coefficients deviates from that predicted by theory. (auth)

29869 CROSS SECTION FOR γ-QUANTUM ABSORPTION BY O^{16} NUCLEI IN THE GIANT RESONANCE REGION. N. A. Burgov, G. V. Danilyan, B. S. Dolbilkin, L. E. Lazareva, and F. A. Nikolayev (Lebedev Inst. of Physics, Moscow and Inst. of Experimental and Theoretical Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 70-8(July 1962). (In Russian)

The cross section for absorption by O^{16} is measured by the absorption method, with a high resolution pair magnetic γ spectrometer employed as the detector. The measurements are performed for energies of 18.9 to 26.6 Mev. The cross section curve has four resonance peaks of several hundred kev width at energies of 22.3, 23.05, 24.3, and 25.15 Mev. In the energy range indicated the integral cross section is about 150 Mev xmb. (auth)

29870 ON THE THEORY OF NEUTRON TRANSFER IN NUCLEAR COLLISIONS. T. L. Abelishvili (Tbilissi State Univ, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 81-3(July 1962). (In Russian)

The energy dependence of the cross section for neutron transfer in nuclear collisions is considered, for arbitrary values of the Q-value of the reaction. (auth)

29871 QUASI-ELASTIC SCATTERING OF FAST PROTONS AND THE HOLE EXCITATION SPECTRUM IN THE N^{14} NUCLEUS. V. V. Balashov and A. N. Boyarkina (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 117-20(July 1962). (In Russian)

The spectrum of hole excitations induced by fast protons in the $N^{14}(p,2p)$ reaction is computed. A comparison with experiments confirms the existence of a quasi-elastic collision mechanism in reactions of this kind. In connection with a discussion of the properties of hole excitation levels, attention is drawn to the existence of a specific class of anomalously stable super-threshold states in light nuclei. (auth)

29872 DISPERSION RELATIONS FOR SCATTERING OF γ-QUANTA ON NUCLEI. S. B. Gerasimov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 43: 193-8(July 1962). (In Russian)

Scattering of low-energy γ quanta by nuclei is considered. Dispersion relations for the scattering amplitude at an angle $\theta = 0°$ are obtained by taking into account contributions of nuclear excited states that are assumed to be represented by poles on the second Riemann sheet of the elastic scattering amplitude; the relations are obtained by taking into account only the nucleus + photon and nucleus + electron–positron-pair intermediate states (other states yield higher corrections in powers of the electric charge e). In a first approximation the final form of the dispersion relations contains only those higher order terms in e that correspond to the contributions from resonances. (auth)

29873 EFFECT OF PHONON EXCITATIONS OF NUCLEI ON THE CHARACTERISTICS OF THE GIANT PHOTOABSORPTION RESONANCE. V. V. Balashov and V. M. Chernov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 227-9(July 1962). (In Russian)

The effect of surface (phonon) excitations of a nucleus on the position and width of the collective dipole state is investigated. It is shown that phonon excitations are one of the main sources of "friction" accompanying dipole oscillations of nuclei. Calculations are carried out for Pb^{208}. (auth)

29874 THEORY OF THE OPTICAL POTENTIAL. A. G. Sitenko (Khar'kov State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 319-26(July 1962). (In Russian)

The scattering of nucleons on density fluctuations of nuclear matter within the nucleus is considered. The scattering coefficient defined by the imaginary part of the optical potential is expressed in terms of the nucleon-nucleon scattering amplitude and the spectral distribution of the space-time correlation function for the nuclear matter density fluctuations. As examples, the following nuclear models are considered: degenerate Fermi gas; superconducting nucleon gas; and Fermi fluid. It is shown that the presence of a gap in the density-fluctuation spectrum of even-even nuclei leads to a decrease of the imaginary part of the optical potential of even-even nuclei compared to the imaginary part of the optical potential of odd nuclei. (auth)

Particle Accelerators

Refer also to abstract 29164.

29875 (CEA-1500) CONTROLE DES RADIATIONS AUPRES DU SYNCHROTRON A PROTONS SATURNE. (Radiation Control Around the Proton Synchrotron Saturne). H. Joffre, J. Lamberieux, and A. Stirling (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 51p.

After giving the main characteristics of the synchrotron at Saclay, the general arrangements made for ensuring the safety of the personnel including specification of radiation levels, automatic devices, and visual indications are given along with a description of the means employed for radiation detection. These detection methods include fixed γ and fast neutron detectors whose indications are centralized on a radiation control panel, and mobile detectors for specific or more precise measurements. Results of radiation level measurements and some results of the diminishing of radiation intensity by wood, concrete, and water are given. (auth)

29876 (HW-SA-2637) A SIMPLE PULSE SHAPE DISCRIMINATOR FOR FAST TIME-OF-FLIGHT SERVICE. J. T. Russell and D. G. Foster, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 7, 1962. Contract AT(45-1)-1350. 12p.

A special-purpose pulse shape discriminator is described which was designed particularly for use with a pulsed-beam time-of-flight system on a Van de Graaff accelerator. (J.R.D.)

29877 (LNF-62/30) ATTIVITA' DEI LABORATORI NAZIONALI DI FRASCATI DAL LUGLIO 1 AL DICEMBRE 31, 1961. NOTIZIARIO NO. 11. (Activity at the National Laboratories of Frascati, July 1, 1961-December 31, 1961. Report No. 11). (Italy. Comitato

Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Apr. 1962. 76p.

Operation of the electrosynchrotron is described. Activities of the cryogenic laboratory, Rafele laboratory, electronics shop, magnet and magnetic measurement laboratory, technological laboratory, computing department, theoretical studies group, health physics service, technical office, and documentation service are discussed. Thirteen experiments underway with the electrosynchrotron are outlined. (M.C.G.)

29878 (NP-11931) SCHERMATURE INTORNO AGLI ACCELERATORI DI ALTA ENERGIA. (Shielding Around High Energy Accelerators). M. Ladu and M. Petilli (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). June 1962. 62p. (RT/PROT(62)1)

The safety shieldings around the high energy accelerators were calculated for 1 μ A of accelerated particles and for energies up to 100 Bev. The thickness-energy curves for different materials and for electrons and protons accelerators separately, are given. (auth)

29879 (NP-11938) FINAL REPORT [ON NUCLEAR PHYSICS]. (Pennsylvania. Univ., Philadelphia). June 1962. Contract N-onr-551(17). 16p.

The theoretical and technical features of a system used to determine and control the operating energy of a 23-Mev betatron are described. By observing the variation in orbit radius as a function of magnet excitation, the shape of the calibration curve to maximum operating energy can be predicted. Although an absolute calibration of the predicted energy scale is possible, the present calibration is empirical and based on only the 16.22-Mev resonance in the $O^{16}(\gamma,n)O^{15}$ reaction. Photoneutron threshold energies based on this energy scale are in good agreement with accepted values. (auth)

29880 (ORNL-1345) ELECTROMAGNETIC RESEARCH DIVISION QUARTERLY PROGRESS REPORT, PART I FOR PERIOD ENDING JUNE 30, 1962. F. T. Howard, ed. (Oak Ridge National Lab., Y-12 Area, Tenn.). Nov. 14, 1952. Contract W-7405-eng-26. 23p.

On the 86-inch cyclotron a 41-kw beam was calorimetered at a net ion loading efficiency of 40%; the average proton current was 1.85 ma at 22.5 Mev. Practical specific yields were determined for (p,2n) reactions on zinc and bismuth. The investigation of products of proton-induced fission of uranium was continued and new techniques are being used in measuring angular distribution of reaction products. The 63-inch heavy particle cyclotron is now in operation; N^{3+} particles were accelerated to ~25 Mev. In preliminary tests, induced activities were detected in carbon, nitrogen, and oxygen targets. A hot-cathode type ion source is ready for test operation. The 22-inch cyclotron is being used in an investigation of the problems associated with the use of r-f and d-c electrodes for the acceleration of protons from the ion source into the dees. Radio-induced corrosion in Inconel tubing containing No. 21 eutectic was produced by proton irradiation in the 86-inch cyclotron; it is shown that the corrosion was not due to thermal effects. Approximately 150 grams of highly purified U^{238} (< 5 ppm U^{235}) were prepared, and two grams of thorium^{230} was enriched to 90.6%. (auth)

29881 (ORNL-1383) ELECTROMAGNETIC RESEARCH DIVISION QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1952. F. T. Howard, ed. (Oak Ridge National Lab., Y-12 Area, Tenn.). Feb. 10, 1953. Contract W-7405-eng-26. 32p.

The development of techniques for measuring angular distributions from internal targets in the 86-inch cyclotron was completed; data were obtained for elastic scattering of protons from Be, C, Al, Ni, Nb, Rh, Ta, and Th; for deuterons from Be and Mo; and for tritons from Be. The 86-inch cyclotron was operated steadily; for a record three-week period it was in operation 75% of the available time with an average proton current of 767 μa. A system for deflecting the beam to an external target is being designed. A number of reactions induced by bombardment of D, Be, C, N, and O with 25 Mev N^{3+} ions in the 63-inch cyclotron were identified; nuclear fusion of nitrogen with carbon and with oxygen was observed. Photographic emulsions are being used in an attempt to measure the range and the energy of nitrogen nuclei. In the 22-inch cyclotron the effects of the shape of the accelerating electrode (for d-c injection of ions) and its spacing from the arc chamber are being investigated. Thorium residue from a previous isotope separation run was recycled to produce $^2/_3$ gram of 88% Th^{230}. The first plutonium isotope separation run was terminated because of a broken electrode. A small but reproducible amount of radiation-induced increase in intergranular corrosion was produced in the Inconel of reactor fuel tubes by proton-irradiation in the 86-inch cyclotron at >3000 watts/cc. (auth)

29882 (PAN-277/I-A) KASKADNYĬ USKORITEL' DEĬTONOV 200 kev RABOTAYUSHCHIĬ KAK ISTOCHNIK NEĬTRONOV 14 Mev S REAKTSII D(T,n)He^4. (A 200 kev Cockcroft-Walton Deuteron Accelerator for Fast Neutrons Production from D(T,n)He^4 Reaction). E. Belevich, E. Yanushevski, and A. Mokvin'ski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). 1961. 14p.

Construction of a Cockcroft-Walton type cascade accelerator for production of 200-kev deuterons is reported. The accelerator was built to obtain 14-Mev neutrons from the D(T,n)He^4 reaction. A D^+ beam from the r-f ion source is focused by an electrostatic lens system at 4.5 m. The ion current under optimum conditions reaches 1 ma. (J.R.D.)

29883 (TID-16309) LINEAR ACCELERATOR PROJECT. Annual Technical Report During Fiscal Year 1962. (Rensselaer Polytechnic Inst., Troy, N. Y.). Contract AT(30-3)-328. 32p.

A brief review of accelerator development is presented. Current activities are reported in pulsed-chopped neutron spectrum measurements for measuring low energy spectra produced by neutron pulses from the Linac, neutron capture cross section experiments including a code (ROAR IV) for reduction of cross section data, and the RAMP system of codes for thermal neutron studies. Other work is reported on neutron thermalization studies by matrix eigenvalue techniques, time dependence of transport phenomena in moderators externally pulsed with neutrons, and studies concerning the sensitivity of the time-dependent neutron spectra to physical parameters and especially to the elements of the scattering matrix. (J.R.D.)

29884 (Y-795) ELECTROMAGNETIC RESEARCH DIVISION PROGRESS REPORT APRIL 1, 1951 TO JUNE 30, 1951. (Oak Ridge National Lab., Y-12 Area, Tenn.). July 16, 1951. Contract W-7405-eng-26. 52p.

Development of the 86-in. cyclotron continues to increase the energy and current of the proton beam. A method of biasing dees improved the operating characteristics of the machine, and the installation of a vacuum lock makes it possible to change targets with less than 1 hr of operation outage. Ion source and target assemblies are illustrated. Neutron-flux attenuations in the maze through the concrete shield for various floor and wall coverings are presented

graphically. A water-cooled target for use in irradiating liquid reactor fuels is sketched. The status of design, component fabrication, and experimental development of the 63-in. cyclotron is reported. Consideration is being given to altering the magnetic field of the 86-in. cyclotron to obtain Thomas-type phase compensation. A model magnet and shims were constructed, and proposed tests are discussed. Production of U^{233} is reported. Ion sources designed for Pu-isotope separation are described briefly. Performance of the ion source designed for multiple ionization of nitrogen is discussed. In the investigation of growth effects produced by thermal cycling of such metals as U, Th, stainless steel, and Al, it was found that resistance heating with He cooling is most effective. (J.E.D.)

29885 (FTD-TT-62-897) INVESTIGATION OF THE ENERGY SPECTRA OF ELECTRONS ACCELERATED BY THE ELECTRIC FIELD OF A MICROTRON RESONATOR. B. Z. Kanter. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 1, 84-7(1962). 7p.

An investigation was conducted to determine the shape of the energy spectra of resonator-accelerated electrons when they are injected in microtrons from hot or cold cathodes. The possibility of a smooth control of the injection current in wide ranges is shown. (J.R.D.)

29886 (FTD-TT-62-935) A BETATRON WITH A SYMMETRIC MAGNETIC FIELD. M. F. Filippov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Elektromekh., No. 2: 131-4(1959). 5p.

Calculated data on a proposed electromagnet which can be used in symmetric betatrons, pulse-fed betatrons, and high frequency betatrons are presented. An advantage of a version of the magnet with armored magnetic circuit is the natural azimuthal homogeneity of the master magnetic field, that does not require correction. Increased gamma radiation is assured with a uniform magnetic field. (J.R.D.)

29887 (FTD-TT-62-1036) A CYCLOTRON WITH TRAJECTORY CONTROL BY MEANS OF A HIGH-FREQUENCY FIELD. A. A. Vorob'ev (Vorob'yev) and E. (Ye.) S. Kovalenko. Translated from Izvest. Vysshikh Uchob. Zavedenii, Fiz., No. 5: 36-8(1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 14119.

29888 BETATRON FOR MELBOURNE. B. M. Spicer (Univ. of Melbourne). Atomic Energy 5, No. 3: 22-6(July 1962).

The characteristics of a Siemens-type betatron are outlined. The machine can produce a maximum x-ray intensity of 100 r/min at energies up to 35 Mev, with an energy stability of ±0.3%. (T.F.H.)

29889 OBSERVATION OF THE POLARIZATION OF THE POLARIZED DEUTERON BEAM OF THE SACLAY CYCLOTRON. René Beurtey, Pierre Darriulat, Robert Maillard, André Papineau, and Jacques Thirion. Compt. rend., 255: 279-81(July 9, 1962). (In French)

A beam of polarized deuterons, in which the intensity at the target was 2×10^8/sec and the energy 22 Mev, was produced. The asymmetries measured in the reaction $C^{12}(d,p)C^{13}$ show the vector polarization of the beam. (tr-auth)

29890 THE COHERENT RADIATION OF SYNCHROTRON ELECTRON CLUSTERS IN A CLOSED RESONATOR. J. Vaclavik. Czechoslov. J. Phys., 12: 432-8(1962). (In Czech)

A study is made of the electromagnetic interaction of electrons in thin relativistic clusters during coherent radiation in a synchrotron. The magnitude and form of the tangential component of the force, acting on an isolated electron of a cluster of electrons, is expressed. (auth)

29891 RADIATION PROTECTION SURVEYS AT HEAVY-PARTICLE ACCELERATORS OPERATING AT ENERGIES BEYOND SEVERAL HUNDRED MILLION ELECTRON-VOLTS. H. H. Rossi, W. Rosenzweig, M. H. Biavati, L. Goodman, and L. Phillips (Columbia Univ., New York). Health Phys., 8: 331-42(Aug. 1962).

The RBE dose in the environs of two high energy accelerators was evaluated utilizing tissue equivalent chambers and spherical proportional counters designed for the measurement of absorbed dose as a function of LET. The method is generally applicable whenever mixed radiation fields are encountered. (auth)

29892 HEALTH PHYSICS CONSIDERATIONS IN THE DESIGN OF THE ARGONNE 12.5 Bev ZERO GRADIENT SYNCHROTRON. R. V. Wheeler (Argonne National Lab., Ill.). Health Phys., 8: 429-33(Aug. 1962).

The Argonne Zero Gradient Synchrotron capable of accelerating some 5×10^{12} protons per pulse to an energy of 12.5 Bev is due to initiate operation in early 1963. During the planning stages of this facility, Radiation Safety cooperated with the various design groups, incorporating control, warning, and monitoring features. Every access to the linear accelerator and synchrotron was categorized, and personnel controls at each were specified. A complete radiation and magnet warning system was devised together with a run-safe switch system that will effect a shut-down of the synchrotron in an emergency situation. In order that remote monitoring of the entire facility may be accomplished efficiently in the future, monitoring stations have been designated and the required cables installed terminating at Radiation Safety panels in the control room. Massive external shielding is required at the ring building to reduce the expected stray radiation backgrounds from the synchrotron. Twenty to fifty feet of earth or its equivalent forms this shield. Shielding calculations indicate this quantity is necessary to reduce the neutron and μ-meson flux to 3 n/cm^2 per sec and 60 μ/cm^2 per sec. (auth)

29893 STRONG FOCUSSING (A NEW SOVIET SYNCHROTRON). V. V. Wladimisrskii (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Priroda, No. 5: 34-40(May 1962). (In Russian)

The design and performance of a strong-focusing synchrotron is described, and the basic parameters of the installation are given: the maximum accelerated proton energy (kinetic) up to 7 Bev, injection energy to 4 Mev, 8 × 11 aperture, magnet system up to 3800 tons with 112 sections. The maximum capacity is 27 mv at 1.5 sec acceleration and 10 cycles per minute. The projected pulse intensity is 10^9 to 10^{10}. Acceleration is achieved in 7 rotation-frequency harmonics with 11 acceleration-frequency variations. (R.V.J.)

29894 MEASUREMENT OF BETATRON OSCILLATION FREQUENCIES ON THE UCLA 50-Mev CYCLOTRON. David J. Clark and J. Reginald Richardson (Univ. of California, Los Angeles). Rev. Sci. Instr., 33: 834-8(Aug. 1962).

The vertical and radial betatron oscillation frequencies were measured on the UCLA 50-Mev spiral-ridge cyclotron. The technique used was that of r-f knockout, in which the internal beam was passed through a pair of exciter plates which provided an r-f electric field. When the frequency was equal to the betatron frequency, a detectable increase in betatron oscillation amplitude or "knockout"

occurred. The knockout as a function of exciter frequency shows a number of resonances rather than a single one. This provides a measurement of radial as well as vertical betatron frequency. Comparisons of the measured frequencies with those calculated from magnetic field measurements are given and show satisfactory agreement. (auth)

29895 VAN DE GRAAFF ENERGY RESOLUTION. G. C. Kyker, Jr. and R. M. Williamson (Duke Univ., Durham, N. C.). Rev. Sci. Instr., 33: 872(Aug. 1962).

The effective energy spread at the controlled proton beam from the Duke 3-Mev Van de Graaff accelerator was measured at a machine energy of 1.75 Mev with the $C^{13}(p,\gamma)$ resonance. The resolution width was found to be 540 ev, indicating a beam spread of ~400 ev. There was no significant change in the spread with slit width, and it is concluded that excellent beam energy resolution may be obtained even with an inexpensive beam deflection magnet. (D.L.C.)

29896 PRODUCTION OF A PULSED PROTON BEAM BY PHASE FOCUSSING. Gerhard Siller (Technische Hochschule, Munich). Z. angew. Phys., 14: 333-40(June 1962). (In German)

The production of a pulsed proton beam is considered. Short pulses were produced with good efficiency from a proton source in the following way: Particles coming from the ion source pass through two high-frequency scattering fields arranged longitudinally at a fixed distance. The scattering fields have the same frequency and follow a sinusoidal pattern. The velocity of the particles was modulated, and by the transmission time effect, numerous convection current pulses were obtained in the field-free drift space. The pulse distance at the input is 6×10^{-7} sec, corresponding to a frequency of 1.66 MHz for both scattering fields. The pulse has a width of 2.5×10^{-8} sec at an amplitude of 1 ma. A longitudinal magnetic field was used for the special guide. The results are in agreement with the theoretical calculations. The work was carried out in connection with the construction of a proton accelerator. (J.S.R.)

29897 COMPACT ELECTROSTATIC ACCELERATOR FOR 2.5 Mev. L. I. Pivovar and V. M. Tubaev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Tekh. Fiz., 32: 713-18(June 1962). (In Russian)

Descriptions are given of an electrostatic accelerator with a 0.75 m^3 steel tank and of the production of 2.55 Mev H^+ and He^+ beams with potential gradients of the order of 2.5 to 3 Mv/m. (tr-auth)

Plasma Physics and Thermonuclear Processes

29898 (ARL-62-374) RESEARCH IN THE MEASUREMENTS AND THEORY OF PLASMOIDS AND THEIR APPLICATIONS TO MISSILES AND SATELLITE TECHNOLOGY. Lawrence C. Scholz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 1962. Contract AF 33(616)-5791. 67p.

High-speed metal spark-derived plasmoids were produced in magnetic fields under high vacuum conditions (10^{-4} torr). The velocity and other properties of these plasmoids were measured under a variety of conditions. Interaction of the plasmoids with obstacles, the magnetic field, and other plasmoids was also investigated. The work described is mainly experimental, although a theoretical program was also carried out. Electrode processes were investigated and a concept of a "best" material is discussed. However, this is a tentative conclusion and further work is needed. Special equipment developed during the program is discussed. This includes capacitor discharge circuits and a high speed camera with an image convertor tube as an electronic shutter. (auth)

29899 (CLM-R-20) ON THE INTERPRETATION OF NEUTRON SPECTRA TO DETERMINE THE CENTRE-OF-MASS MOTION OF FUSING DEUTERONS. B. A. Ward (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Feb. 1962. 10p.

The interpretation of neutron energy spectra to determine the center-of-mass velocity of the fusing plasma deuterons in high-intensity pulsed discharges is described. An approximate theory is presented enabling the shape of the neutron spectra from mass movement of fusing deuterons to be predicted. This theory was applied to the interpretation of experimental neutron spectra in terms of simple models of the movement of the reacting ions. (auth)

29900 (CRSR-116) PLASMA SHEATHS AND THEIR EFFECTS ON ANTENNAS. Stanton J. Peale (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). May 1962. Contract AF49(638)-915. 67p.

An investigation of particle losses from plasma by neutralization at the solid boundary was conducted. It was found that the lack of conservation of particles does not allow the establishment of Maxwell density distribution for either electrons or ions in a plasma sheath. Thus, in situations where a finite body is moving at a velocity comparable to ion thermal velocities, the ion density will be approximately constant and equal to that in the undisturbed plasma, while the electrons can be approximated by a Maxwell density distribution with only small error. Plasma sheaths are known to hamper some techniques for measuring plasma parameters. An example of this is the effect on the impedance measurements of an antenna imbedded in plasma. To investigate situations where the sheath might be ignored with the subsequent realization of reliable plasma data from antenna impedance measurements, a long thin wire in plasma and photon streams is considered. (J.R.D.)

29901 (D1-82-0174) DISPERSION OF WAVES IN HOT PLASMAS (thesis). Harold B. Liemohn (Boeing Scientific Research Labs., Seattle). June 1962. 130p.

Submitted to Univ. of Washington, [Seattle].

The propagation characteristics of small-amplitude waves in hot plasmas are discussed assuming specific functional forms for the equilibrium distributions. The space-time behavior of initial density perturbations (acoustic mode) was analyzed, including second-order effects, using a one-dimensional Cauchy velocity distribution of the form $(v^2 + a^2)^{-1}$. The thermal effects on right-hand circularly polarized electromagnetic waves propagating along a magnetic field in a plasma (longitudinal extraordinary mode) were evaluated for a three-dimensional Cauchy distribution of the form $(v^2 + a^2)^{-3}$ and a step-function distribution. In the latter case the relativistic corrections for the propagation characteristics were studied qualitatively using a step-function momentum distribution. For the acoustic mode, the initial density perturbation of the plasma was assumed to be sinusoidal in space. The first-order solution had an exact analytic form which gave damped oscillations at a thermally shifted plasma frequency. The thermal damping was similar to that originally obtained by Landau. The nonlinear interference between the density wave and its field produced second harmonics in both space and time which appeared in the second-order solution. The harmonic structure sug-

gested a "spectral decay" of the initial perturbation energy. In general, the oscillation frequency and damping decrement increased with temperature so that at sufficiently high temperatures all forms of ordered motion were destroyed by the random thermal motion. The nonrelativistic dispersion equation for the longitudinal extraordinary mode was solved for all frequencies including cyclotron resonance. In general, thermal effects reduced the infinite discontinuity in phase at the cyclotron resonance to a finite value and caused thermal damping of the propagating wave below resonance. The absorption coefficient increased with temperature and could appreciably decrease the intensity of signals propagating through hot media. The results were applied to whistler propagation along geomagnetic field lines in the exosphere. If the observed frequency cutoff arose from thermal damping, a temperature of 10^5 °K was required in the electron component near the geomagnetic equator at four earth radii geocentric. Solutions of the dispersion equation for a relativistic plasma were calculated at certain frequencies, and the qualitative behavior of the index of refraction was evident from these specific results. Relativistic effects were found to lower the cyclotron resonance and the frequency at which the index vanishes. (auth)

29902 (D1-82-0183) ON THE INSTABILITY OF ELECTRON-HOLE PLASMAS IN A LONGITUDINAL MAGNETIC FIELD. O. Holter (Bergen. Universitetet. and Boeing Scientific Research Labs., Seattle). July 1962. 29p.

The effect of a background of thermal holes was included in a theory for the screw instability in electron-hole plasmas in a semiconductor. Calculations are restricted to the case of low injection levels (injected current ≪ Ohmic current) in p-type material. The theory is developed along the general lines of previous works by various authors. Compared with experimental results, the theory predicts heating of the plasma to temperatures of the order of the optical phonon energy. (auth)

29903 (DCAS-TDR-62-112) AN EXPERIMENTAL STUDY OF THE PROPAGATION OF HYDROMAGNETIC WAVES IN A PLASMA. Ieuan R. Jones and Roy W. Gould (Aerospace Corp. Physical Research Lab., El Segundo, Calif.). Apr. 5, 1962. Contract AF 04(647)-930. 52p. (TDR-930(2210-02)TR-1)

The n = ±1, E mode of hydromagnetic wave propagation was studied in a cylindrical plasma waveguide. Excitation at 1.0, 2.3, and 3.0 megacycles per second was achieved by means of a circular current-carrying loop immersed in the plasma. Magnetic probes, distributed along the length of the waveguide and capable of insertion along a radius, were used to determine the radial dependence and direction of the signal fields and, hence, the nature of the propagating mode. The probes were also used to detect the propagation of the waves. Measurement of wave velocity was interpreted to yield the ion density in the plasma, and, furthermore, measurement of wave velocity at different intervals after plasma preparation was interpreted to yield the ion density decay rate. Experiments were performed to detect the rotation of the plane of polarization of the signal fields. (auth)

29904 (LAMS-2721) QUARTERLY STATUS REPORT OF THE LASL CONTROLLED THERMONUCLEAR RESEARCH PROGRAM FOR PERIOD ENDING MAY 20, 1962. (Los Alamos Scientific Lab., N. Mex.). June 1962. Contract W-7405-ENG-36. 18p.

Results of injecting deuterium in Picket Fence II B indicate that the second injection gun abruptly spills out any previously trapped plasma. In Picket Fence III the duration of neutron signals produced by the trapped fast ions was found to increase with the magnetic field up to the maximum field strength of 2300 G at the ring cusp. Experiments with coaxial guns are described along with work underway to construct a useful kinetic theory of plasmas which includes electromagnetic radiation. A preionization arrangement for SCYLLA, using a rapidly oscillating B_z field, which should result in plasma with lower impurities was installed. An apparatus is being tested for analysis of injected plasma in SCYLLA III. In other work, SCYLLA I spectroscopy was continued and beam splitting as an injection method was studied for transverse magnetic fields. Experiments with plasma shorting plates were conducted in which it was found that there is a possibility of using a shorting technique for transverse injection. (J.R.D.)

29905 (MATT-Q-18) QUARTERLY REPORT [ON PLASMA PHYSICS] COVERING PERIOD JANUARY 1–MARCH 31, 1962. (Princeton Univ., N. J. Plasma Physics Lab.). Apr. 30, 1962. Contract AT(30-1)-1238. 42p.

Development of the C stellarator is reported. Plans for addition of a diverter, the SF-2 helical coil, and a magnetic pumping system are discussed. It is noted that while significantly higher temperatures in C stellarator must await the completion and installation of these additional components, significant information on the energy balance and plasma confinement should be obtainable from the device in its present form. The mass spectrometer in the pump line indicates that the partial pressure of the various impurities is less than 10^{-9} torr. Measurements on the B-3 stellarator indicate that imposing a strong radial field (100 v/cm) on the plasma reduces the rate at which the electron density decays. Preliminary data obtained in B-66 stellarator ion temperature measurements indicate deuteron energies of several hundred volts while the r-f voltage is being applied. When ion cyclotron heating ceases, the ion energies decay with a time constant about equal to 30 μsec. Numerical calculations for one-dimensional plasmas indicate that the ion-wave instability produces relatively mild effects as compared with the violent bunching and anomalous resistance associated with the two-stream instability. Details of engineering and development on the Model C and smaller systems are included. (J.R.D.)

29906 (NYO-9191) SHERWOOD PROGRESS REPORT NO. 5, JANUARY 1961-DECEMBER 1961. J. Berkowitz (New York Univ., New York. Courant Inst. of Mathematical Sciences). Apr. 16, 1962. Contract AT(30-1)-1480. 21p. (MF-30)

Investigations in the project are presented concerning adiabatic and non-adiabatic charged particle trajectories, cusped geometries, collisionless shock theory, and wave propagation. Information concerning plasma theory is also included along with a bibliography of published information. (J.R.D.)

29907 (SCTM-81-59(51)) THE RECTIVERTER. H. H. Sander (Sandia Corp., Albuquerque, N. Mex.). Mar. 10, 1959. Contract [AT(29-1)-789]. 22p.

A high-voltage, high-current switching gap is described which has three main electrodes combined with a magnetic field. The magnetic field, obtained from a permanent magnet, causes the arc in the gap to be automatically diverted from the main electrode to a "crowbar" electrode, or from the load electrode to the crowbar electrode. Diverting can be made to occur at the peak of the first half-cycle of current flow, or, if desired, at the crossing of the zero axis at the end of the first half-cycle. Thus

when discharging a capacitor through an inductive load, instead of the load receiving a ringing, damped wave train of current as it does with the usual two-electrode gap, it receives only one neatly rectified, or "rectiverted", pulse of d-c current. As a further benefit, the discharge capacitor can be ideally discharged, i.e., when diverting at peak current, the capacitor delivers only at 90° pulse of current (from full charge to zero) and does not get recharged in the reverse direction. The device shows promise of handling potentials up to the range of 100 kv and current in the order of 10^5 amp. (auth)

29908 (TID-12518) X-RAY SPECTROSCOPIC MEASUREMENTS OF HIGH-TEMPERATURE PLASMAS. F. L. Ribe, G. A. Sawyer, and T. F. Stratton (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 14p. (LADC-4791)

A beryl, single-crystal, x-ray diffraction spectrometer was constructed and used to study the x-ray spectrum emitted from the deuterium plasma in the Scylla fast magnetic compression experiment. Prominent lines were identified from the HeI-like spectra of Na X, Mg XI, Al XII, and Si XIII wall impurity ions as well as the H-like Lyman series of O VIII. The shape and absolute magnitude of the continuum spectrum indicated that the plasma electron temperature is 345 ± 40 ev and that the soft x-radiation arises primarily from electron recombination with small amounts of highly stripped impurity ions. Results of broadening measurements of the x-ray optical spectral lines are also given. (auth)

29909 (TID-16339) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Report for April 1, 1962 to July 1, 1962. (New York Univ., New York). July 31, 1962. Contract AT(30-1)-2397. 6p.

Effort during the report period was devoted primarily to the design of an alkali plasma source and its associated vacuum system. The basic goal of this work is achievement of a uniform temperature of up to 2500°K in a small volume of alkali vapor at low pressure which is at equilibrium with its container. Discussions concerning plasma chamber design, materials, temperature distribution, pressures and temperatures, and the vacuum system are included. The status of the high-energy neutral beam work is also reported. (J.R.D.)

29910 (AEC-tr-5033) A NECESSARY HYDROMAGNETIC STABILITY CRITERION FOR A PLASMA WITH REVOLUTION SYMMETRY. Claude Mercier. Translated from Nuclear Fusion, 1: 47-53(1960). 21p.

Also issued as report CEA-1863.

A stability criterion is calculated for a plasma with revolution symmetry. It corresponds to localized displacements in the neighborhood of constant pressure surfaces on which the magnetic lines of force are closed. This criterion reduces to that of Suydam in the case of cylindrical symmetry. (auth)

29911 (FTD-TT-62-336) REPULSION OF ELECTROMAGNETIC WAVES BY PLASMA. V. I. Kurilko and V. I. Miroshnichenko. Translated from Ukrain. Fiz. Zhur., 6: 415-16(May-June 1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 4922.

29912 PLASMA GENERATORS (PLASMATRONS, ARC PLASMA TORCHES, ARC HEATERS). W. S. Brzozowski and Z. Celiński (Inst. of Nuclear Research, Polish Academy of Science, Warsaw). Bull. acad. polon. sci., Sér. sci., tech., 10: 293-9(1962). (In English)

Generators, capable of producing plasma jets at temperatures of about 15,000°C, with power consumptions of about 50 kw are described. The heat source used in the generators is a gas-vortex-stabilized d-c arc heater. The generator anode is in the form of an internally water-cooled Cu outlet nozzle, and the cathode is in the form of a W rod. (T.F.H.)

29913 EMISSION OF A PLASMA JET IN THE VICINITY OF THE PLASMA FREQUENCY (FAR INFRARED). Francois Cabannes, Joseph Chapelle, Armand Hadni, and Guy Rollet. Compt. rend., 255: 274-6(July 9, 1962). (In French)

In the vicinity of the plasma frequency the emission of a jet undergoes an abrupt variation as a function of the frequency as a result of a rapid variation of the refraction index. The principal parameters of the plasma can be determined by detecting this variation experimentally. The sharp variation of the spectral luminescence at the transition of the plasma frequency was used to determine experimentally the plasma frequency. The theoretical and experimental results on the variation of the luminescence are shown graphically. (J.S.R.)

29914 TIME PRODUCTION AND SPATIAL DISTRIBUTION OF MACROSCOPIC SPACE CHARGES IN D-C DISCHARGE PLASMA. L. Pekárek (Inst. of Physics, Czechoslovok Academy of Science, Prague). Czechoslov. J. Phys., 12: 439-49(1962). (In English)

It is shown in a one-dimensional approximation that, around a disturbance in the ion concentration $n_+(x,t)$ in the axial direction of a cylindrical plasma, a corresponding electron distribution $n_-(x,t)$ is established with such a large velocity that under the usual conditions of a discharge plasma this electron distribution follows the relatively slow changes in ion concentration practically without delay. As long as the disturbance of the ions is $n_+(x) \pm 0$, a space charge $q_0(n_+ - n_-)$ is produced and maintained in the plasma even if the disturbance of the equilibrium state of the plasma in the initial stage is electrically neutral (i.e., $n_+(x,t = 0) = n_-(x,t = 0)$). The dimensions of these space charges can be many orders larger than the Debye characteristic length l'_p; this is shown on an example of a spatially periodic curve $n_+(x)$. The unique (quasi-stationary) expression of the electron of the electron concentration n_- by means of the deflection of the ion concentration $n_+(x,t)$ permits a simplification of the solution of the problems connected with axial disturbances of the homogeneous state of a plasma, since $n_-(x,t)$ can be eliminated from the equations of continuity of the plasma, and the problem becomes that of determining the curve of the ion concentration n_+ from the equations modified in this way. (auth)

29915 THEORY OF MOVING STRIATIONS IN PLASMA OF D-C DISCHARGE. I. BASIC EQUATION AND ITS GENERAL SOLUTION. L. Pekárek and V. Krejčí (Inst. of Physics, Czechoslovak Academy of Science, Prague). Czechoslov. J. Phys., 12: 450-60(1962). (In English)

As a base for the theory of moving striations a partial integro-differential equation is derived from the equations of continuity, the Laplace-Poisson equation, and a further relation between the electric field and the temperature of the electrons. Apart from the processes necessary for the actual formation of striations and for the amplification of the wave of stratification, the equation also includes the processes defining the Debye length of the electrons, the influence of the axial electric field and of its local deflections on the motion of current carriers, and the direct influence of the deviations in concentration of the electrons on the rate of production of current carriers. In deriving the equation the main attention is paid to the physical sense

of the mathematical operations applied. The general solution is found by the method of the two-sided Laplace transformation and is described by triple integral convolution. (auth)

29916 DEVELOPMENT OF A PLASMA FACILITY AND SPECTROGRAPHIC DETERMINATION OF PLASMA TEMPERATURES. Donald Robert Haworth (Oklahoma State Univ., Stillwater). Dissertation Abstr., 23: 187 (July 1962).

A plasma facility was established for the study of the properties of high temperature, partially ionized gases; and a method for the spectrographic determination of plasma temperatures is presented. The establishment of the plasma facility was completed and successful preliminary operation was achieved using argon and argon with hydrogen tracer as the stabilizing gases. Power inputs to the system ranged from 6 to 17 kw. The analytical procedure for determining plasma temperatures was based on the theory of Stark broadening of the spectral lines of hydrogen which was added in small quantities to the main plasma flow. The experimentally broadened line profiles for the H_β and H_γ spectral lines were compared to the theoretical profiles for these lines which are functions of the temperature and pressure of the plasma. For a constant plasma energy level, the variation in hydrogen tracer from 1.6 to 2.9% by volume of the argon flow was shown to have a negligible effect on the calculated temperature distribution in the plasma. Also, for a fixed percentage of hydrogen (2.9%), the temperature distributions obtained from the analysis of the H_β and H_γ spectral lines were in agreement within the accuracy of the method used for the calculations. (auth)

29917 RECENT EXPERIMENTAL RESULTS IN THE AREA OF CONTROLLED THERMONUCLEAR FUSION. J.-P. Poffé and F. Waelbroeck (Euratom-C.E.A., France). Énergie nucléaire, 4: 172-81(May-June 1962). (In French)

A review of recent experimental data on controlled thermonuclear fusion is given with emphasis on the difficulties encountered, the progress made, and future possibilities. The three principal experimental devices studied are pinch, stellarator, and linear magnetic bottles. (J.S.R.)

29918 PROPERTIES OF A PLASMA CREATED BY AN ELECTRON BEAM. P. Hedvall (Royal Inst. of Tech., Stockholm). J. Appl. Phys., 33: 2426-9(Aug. 1962).

Some properties of a plasma formed by an ionizing electron beam are investigated. The electron beam and the plasma are confined by an axial magnetic field. The experiments, which are performed in argon in the pressure range 5×10^{-5} to 1×10^{-3} mm Hg, show that densities of the order of 10^{12} to 10^{13} ion pairs/cm^3 can be achieved. Some types of oscillations that occur are discussed. (auth)

29919 CONTAINMENT OF PLASMAS BY HIGH-FREQUENCY ELECTRIC FIELDS. Magda Ericson (Massachusetts Inst. of Tech., Cambridge), C. Seabury Ward, Sanborn C. Brown, and S. J. Buchsbaum. J. Appl. Phys., 33: 2429-34(Aug. 1962).

A cylindrical plasma column is produced in hydrogen by a microwave electric field crossed with a static magnetic field. Under certain conditions of gas pressure, magnetic field, and strength of the microwave field, the plasma does not entirely fill the volume available to it but appeared as a narrow, perfectly stable, cylindrical column with a diameter as small as one-fourth of the diameter of the discharge tube. The experimentally observed properties of this "constricted" discharge are described. It is shown that these properties can be explained by treating the plasma as a compressible dielectric medium. (auth)

29920 COUPLING OF MODES BETWEEN A SLOW-WAVE PLASMA MODE AND A HELIX. S. F. Paik (Raytheon Co., Burlington, Mass.). J. Appl. Phys., 33: 2468-73 (Aug. 1962).

Propagation of waves in a transmission system consisting of a plasma column and a coaxial helix is investigated. The propagating characteristics of the structure are analyzed by a straightforward field analysis. It is demonstrated that the field solution can be reduced to a simple circuit equation describing two coupled tuned circuits. This analytical result shows that the propagation of waves in the plasma-helix structure can be described by a purely capacitive coupling of modes between the space-charge modes of the plasma column and the helix mode. The limitation of perturbation techniques is discussed and the condition for the validity of the small perturbation assumption is given. The experimental method of separating and measuring the two coupled modes of propagation by means of mode-selecting techniques is described. (auth)

29921 ELECTRON TEMPERATURE IN PARTIALLY IONIZED GASES SUBJECT TO INTENSE ac FIELDS. S. Visvanathan (Valley Forge Space Tech. Center, Philadelphia). J. Appl. Phys., 33: 2481-3(Aug. 1962).

A strong external electric field in a plasma produces electrons with a temperature considerably higher than the temperature of the neutral gas in a plasma. The currents produced by such electrons in a strong a-c field are studied. The effect of a strong a-c field on the plasma is examined. It is found that the current has a component of frequency ω and a weaker component of frequency 3ω. The results are valid if $\nu_0 > \omega > \delta\nu_0$, where ν_0 is the collision frequency of the electrons and δ is the fraction of energy transferred to the neutrals in a single collision. The effect of a strong steady electric field, on which a weak a-c field of frequency ω is superimposed is investigated. Here the current has a steady component plus an additional a-c component of frequency ω, which leads the a-c field. This latter case is also studied taking account of electron-ion collisions. The measurement of the current and phases leads to a determination of the collision frequency. (auth)

29922 HIGHLY IONIZED HOLLOW CATHODE DISCHARGE. L. M. Lidsky (Massachusetts Inst. of Tech., Cambridge), S. D. Rothleder, D. J. Rose, S. Yoshikawa, C. Michelson, and R. J. Mackin, Jr. J. Appl. Phys., 33: 2490-7(Aug. 1962).

A hollow cathode discharge (HCD) is described that produces a highly ionized steady-state plasma ($n_e \approx 10^{13}$ to 10^{14}/cm^3) at a temperature 1 to 10 ev, in a volume as large as 10^4 cm^3, with background neutral gas density $\approx 10^{13}$/cm^3. The HCD is generated by the prescription: gas flow (H_2, He, Ar, or N_2) 0.05 to 2 cc STP/sec through a refractory metal hollow cathode tube into a vacuum; any anode; 20 to 200 v d-c applied. An axial induction of 100 to 1000 g is used to collimate the discharge and to aid in starting by r-f excitation. The HCD runs from the cathode interior, deep enough that $p_0 d \approx 1$ cm × mm Hg. Current range is 2.0 to 300 amp. Various electrode configurations and a wide range of operating parameters are studied. The external plasma density and temperature are measured by Langmuir probes. A discussion is given of the confinement mechanism and of the energy balance, both in the external plasma and in the region of the cathode itself. (auth)

29923 RESONANCES IN THE POSITIVE COLUMN OF A LOW-PRESSURE ARC DISCHARGE. J. H. Battocletti (Loyola Univ., Los Angeles) and W. D. Hershberger. J. Appl. Phys., 33: 2618-24(Aug. 1962).

When an electromagnetic wave of fixed frequency is incident on the cylindrical positive column of a low-pressure mercury vapor arc discharge with its electric field and direction of propagation both perpendicular to the column

axis, a spectrum of resonances of reflection and transmission occurs as the discharge current of the positive column is varied. In addition to the expected cylindrical plasma resonance, a set of lesser resonances may be distinguished. The locations of these resonances are studied experimentally as functions of temperature and signal frequency for four tubes of different cross sections. It is shown that temperature, which is governed by losses in the plasma column and by the ambient temperature, has a substantial effect on the location of the resonances. By using this effect, spectra of resonances are obtained over a frequency range of 4400 to 22,000 Mc for the smallest tube. In addition, the sharpness of the cylindrical plasma resonance is calculated from experimental data and compared with theoretical curves of Q determined from equations that take into account radiation and collision damping. (auth)

29924 SCATTERING AND CONVERSION CROSS SECTIONS IN INHOMOGENEOUS PLASMA. Marshall H. Cohen (Cornell Univ., Ithaca, N. Y.). J. Geophys. Research, 67: 2729-39(July 1962).

A general scattering theory is developed for a magnetic-field-free plasma, allowing for both transverse and longitudinal waves. Cross sections are derived, which give the scattered components in terms of the frequencies of the incident and scattered waves, and the intensities of the appropriate components in the spectrum of density variations. The theory includes several other scattering formulations as special cases. A number of special features of the cross section formulas are discussed. The effect of thermal irregularities is considered. Ionosphere "incoherent scatter" experiments, and solar type II and III bursts, are discussed qualitatively. (auth)

29925 STUDY OF THE TRAJECTORIES OF IONS IN A MAGNETIC MIRROR CONFIGURATION. I. POSSIBILITY OF TEMPORARY CAPTURE BY A MAGNETIC CONFIGURATION OF A CHARGED PARTICLE COMING FROM THE EXTERIOR. C. Gourdon (Centre d'Études Nucléaires, Fontenay-aux-Roses, France). J. phys. radium, 23: 291-6 (May 1962). (In French)

For a charged particle, moving in an axial symmetrical magnetic field, one can determine an absolute boundary, if the vector potential is known in whole space and if the initial conditions of motion are known. The equation of the boundary surface (a Stormer equipotential surface) is derived using the invariance of the canonical angular momentum. Qualitative properties of various types of boundaries are studied, and the possibility is shown of obtaining temporary capture of particles, injected in the configuration. The dependence of the degree of capture on the initial parameters was studied by machine calculation of trajectories. (auth)

29926 A SPECTROSCOPIC STUDY OF THE PLASMA IN THE PHILLIPS PULSE DISCHARGE. O. S. Pavlichenko and L. A. Dushin. Optics and Spectroscopy (U.S.S.R.) (English Translation), 12: 301-3(May 1962).

Intensity oscillograms of hydrogen spectral lines in a pulse discharge with cold cathode in a magnetic field (PIG) show two maxima. The first is connected with the passage of current; the second appears after the current ceases. Possible mechanisms of line excitation are discussed. It is conjectured that the second maximum is connected with volume recombination of charged particles. (auth)

29927 PLASMA-BROADENED CESIUM LINES. Philip M. Stone and Lewis Agnew (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 127: 1157-62(Aug. 15, 1962). (LADC-5244)

Profiles of isolated plasma-broadened lines have been calculated and measured for the fundamental series (5D–nF) of cesium. The calculations used the static theory for the ion interactions and the classical path, nonadiabatic impact approximation for the electron interactions. The necessary matrix elements have been obtained from wave functions specially determined for this purpose. The calculations were made for plasma ion densities in the range from 3×10^{13} to 1×10^{16} cm^{-3} and temperatures from 2000° to 10,000°K. A scanning monochromator was used to measure profiles of lines emitted from a hot-cathode low-voltage discharge. Plasma densities and electron temperatures were determined from continuum intensity measurements. Line intensities were also measured. Observations were made at ion densities from 3.2×10^{13} to 1.6×10^{15} cm^{-3} with temperatures between 2300° and 6000°K. Experimental and theoretical widths are presented and compared. The ratio of measured to calculated width averaged over the data points is 0.99 ± 0.18. The widths are nearly proportional to ion density and are insensitive to temperature. Predicted values of line shift are also given. (auth)

29928 VACUUM AND ULTRAVACUUM IN AN ION INJECTION AND MAGNETIC MIRROR EXPERIMENT. E. Fischhoff, F. Prevot, and Z. Sledziewski (Association Euratom-CEA sur la Fusion, Fontenay-aux-Roses, France). Vide, 17: 195-200(May-June, 1962). (In French)

The vacuum system of an ion injection magnetic mirror device is described. The tube using gold gaskets is bakeable up to 400°C. Oil diffusion units give a base pressure below 10^{-9} mm Hg. These units are arranged to provide differential pumping for local gas sources. In addition ion pumping and getter pumping will be used. The problem of measuring transient low pressures is briefly discussed. (auth)

29929 INVESTIGATIONS ON DIRECT CURRENT ARCS FOR THE SPECTROCHEMICAL ANALYSIS FOR THE STABILIZATION OF PLASMA TEMPERATURE. Egon Thiel and Hans Krempl (Technische Hochschule, Munich). Z. angew. Phys., 14: 341-7(June 1962). (In German)

Measurement of the temperature and operating voltage on d-c arcs as a function of current and electrode spacing showed that at 10 amp and above the natural oscillations of the temperature can be compensated by regulation of the current intensity. At 2 mm electrode spacing, the temperature-current variation is 5.3×10^{-3} amp/°K. In order to suppress the observed oscillations of ±320°K, a control current of ±2 amp was necessary. The temperature oscillations were measured with the help of an analog divider which—with a response time of 1 msec—was developed for this purpose. The Mg II lines were used as temperature indicators, and their utility was investigated both theoretically and practically. The absolute temperature determination made at approximately 10,000°K gave a higher value than is obtained for most similar determinations. This was traced back to the measurement method and the high "normal temperature" of Mg II. (tr-auth)

29930 THE TRANSIENT INTENSITY PATTERN IN THE AFTERGLOWING PLASMA OF PURE NITROGEN. Herbert Heinrich Broemer and Klaus Fette (Technische Hochschule, Brunswick). Z. Physik, 168: 411-18(1962). (In German)

The afterglow of nitrogen especially prepared to produce an auroral afterglow was investigated after excitation with r-f discharge. The intensity of the first-positive system, the second-positive system, and the first-negative system showed, after a remarkable drop, an increase to a maximum. The height and the time occurrence of the maximum were investigated quantitatively as function of pressure

and excitation conditions. The maximum could only be observed with pressures >1.8 Torr. There is strong evidence that the afterglow emissions of the three band systems during the maximum is governed by a special excitation mechanism common to all band systems. (auth)

29931 SPATIAL AMPLIFICATION OF VARIABLE MAGNETIC FIELDS DURING MAGNETOACOUSTIC RESONANCE. I. A. Kovan, B. I. Petrushev, V. D. Rusanov, G. N. Tilinin, and D. A. Frank-Kamenetskii. Zhur. Eksptl'. i Teoret. Fiz., 43: 16-20(July 1962). (In Russian)

Magnetoacoustic resonance under linear conditions is investigated experimentally. It is demonstrated that under resonance conditions, a magnetic field in a plasma may increase by several times as compared to the initial field. (auth)

29932 A HYDRODYNAMIC DESCRIPTION OF THE MOTION OF CHARGED PARTICLES IN A WEAKLY IONIZED PLASMA. Yu. L. Klimontovich and V. Ebeling (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 146-52(July 1962). (In Russian)

A statistical deduction is presented for equations in the hydrodynamic approximation describing the motion of charged particles in a weakly ionized plasma. Among the hydrodynamic functions required for a description of this motion are the space correlation functions. Interaction between charged and neutral particles is described by introducing an effective collision rate. Some examples of solution of the equations obtained are considered. (auth)

29933 MAGNETO-ACOUSTIC WAVES IN A CYLINDRICAL PLASMA COLUMN FOR WHICH NONLINEARITY AND ABSORPTION ARE TAKEN INTO ACCOUNT. S. I. Soluyan (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 43: 185-92(July 1962). (In Russian)

Propagation of converging waves in a cylindrical plasma column is analyzed on the basis of the equations of magnetohydrodynamics, taking into account nonlinearity and absorption. The analysis is carried out by simplifying the initial set of equations. This approximation is valid for small initial perturbations, small dissipation, and cylinder radii that are large compared to the wave length. The formation and gradual "disintegration" of the fronts in a converging cylindrical magneto-acoustic wave are studied, and the dissipation energy is determined as a function of radius of the cylindrical plasma column. (auth)

29934 DIAMAGNETIC INSTABILITY OF A PLASMA WITH A LARGE ION LARMOR RADIUS. A. B. Mikhailovskii. Zhur. Eksptl'. i Teoret. Fiz., 43: 230-3(July 1962). (In Russian)

A condition for diamagnetic instability of a plasma with an anisotropic ion velocity distribution is derived, for an arbitrary ratio of the perturbation wavelength to the ion Larmor radius. (auth)

29935 ON THE MAGNETOHYDRODYNAMIC DESCRIPTION OF PLASMA. R. V. Polovin and K. P. Cherkasova. Zhur. Tekh. Fiz., 32: 649-56(June 1962). (In Russian)

One-dimensional magnetodynamic equations and Ohm's law were developed for a multicomponent plasma. The analysis is confined to three-component plasma and to dissipation losses in magnetic field. (R.V.J.)

29936 PERIODICAL ELECTROSTATICAL FIELDS IN ELECTRON PLASMA. F. M. Nekrasov. Zhur. Tekh. Fiz., 32: 663-8(June 1962). (In Russian)

A nonlinear kinetic equation approximation was derived for a periodic electrostatic field in an electron plasma. The distribution function is suitable only for the case of a periodic field. Maximum amplitudes were found for a self-congruent field and for the potential of a plasma with small and large relative beam velocities. Expressions are developed for spatial periods in weak fields. The results were generalized for constant velocity wave distribution. (tr-auth)

29937 INTERACTION BETWEEN A CHARGED PARTICLES BEAM AND PLASMA. A. A. Rukhadze. Zhur. Tekh. Fiz., 32: 669-73(June 1962). (In Russian)

A generalized method is suggested for studying interactions between an unlimited relativistic charged particle beam and a plasma. An analysis of two identical interacting plasma fluxes illustrates the simplicity of the method. (tr-auth)

29938 THE FLIGHT OF PLASMA CLOTS THROUGH MAGNETIC FIELDS (MAGNETODYNAMIC TRAPS). G. A. Askaryan. Zhur. Tekh. Fiz., 32: 674-7(June 1962). (In Russian)

An analysis was made of the axial stability and the density of a small dense cluster of plasma passing through a variable-vector magnetic field that turns isotropically in the moving cluster coordinate system, exerting a constant mean pressure on the cluster surface. Expressions were developed for localized and axially stable clusters. (auth)

29939 THE PRODUCTION OF A PURE HYDROGEN PLASMA. B. G. Safronov, V. G. Voitsenya, and I. I. Komovalov (Inst. of Physics and Tech., Academy of Sciences, Khar'kov). Zhur. Tekh. Fiz., 32: 678-81(June 1962). (In Russian)

Separation of pure hydrogen plasma from heavy ions during plasma cluster motion in a toroidal magnetic field is described. The separated ($\sim 10^{10}$ cm^{-3} density) mass spectrally pure plasma is described by using a single-particle model without consideration for particle interactions in the cluster. (tr-auth)

29940 DETERMINATION OF ELECTRON SCATTERING CROSS-SECTIONS ACCORDING TO THE WEAK-IONIZING GAS ELECTROCONDUCTIVITY. D. N. Mirlin, G. E. Pikus, and V. G. Yur'ev (Inst. of Semiconductors, Academy of Sciences, Leningrad). Zhur. Tekh. Fiz., 32: 766-9(June 1962). (In Russian)

Cross sections for slow electron scattering at various temperatures were determined by the conductance of weakly ionized plasma. The cross section for electron scattering on cesium atoms at 1500°K was found to be 2×10^{-14} cm^2. (R.V.J.)

29941 MAGNETOGASDYNAMICS AND PLASMA DYNAMICS. Shih-I Pai. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1962. 206p. $14.00.

The fundamental equations of plasma dynamics are analyzed from the macroscopic viewpoint (i.e., from the viewpoint of continuum theory), with attention to such cases as magnetogasdynamics (MGD), magnetohydrodynamics (MHD), electromagnetodynamics, and radiation-MGD. Simple flow problems of MHD and MGD are investigated. Plasma is initially considered as a single fluid, having a definite composition; subsequently, deviations from single-fluid behavior such as ionization, plasma oscillations, and particle motions are studied. The microscopic viewpoint of plasma dynamics (i.e., the kinetic theory of plasma) is summarized. The relation between the macroscopic and microscopic treatments is discussed. (T.F.H.)

29942 RESEARCH ON CONTROLLED THERMONUCLEAR FUSION. Bibliographical Series No. 7. (International Atomic Energy Agency, Vienna). June 1962. 590p. $4.00(IAEA). (STI/PUB/21/7).

References (4957) on research in the field of controlled thermonuclear fusion are given to U. S. and foreign reports, journals, conferences, patents, and bibliographies published from January 1955 to December 1961. Theoretical and experimental studies on plasma, interaction of particles and shock or electromagnetic waves with plasma, problems of magnetohydrodynamics, and gaseous discharges are covered. References to bibliographies on thermonuclear research are given separately. A separate author index is also included. (P.C.H.)

29943 IONIZATION IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Stirling A. Colgate (Univ. of California, Livermore). p.373-86 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Both in magnetohydrodynamic shocks and in accelerated, partially ionized gas flow across a magnetic field, space-charge separation occurs that establishes very large electric fields in the direction of motion. The width of the current layers associated with the acceleration is never less than the electron Larmor radius with no collisions, and is broadened by electron collisions to a width solely determined by the effective resistivity. The electrons gain an energy, regardless of collisions, equal to the electric potential difference across the layer. For $\omega\tau < 1$(ω = electron cyclotron frequency, τ = collision time), this potential corresponds to the change in kinetic energy of mass motion per ion. For slightly ionized gases, the additional stress of neutral ion collisions within the layer can make the electric potential (and hence gain in electron energy) very large for only modest changes in mass velocity. Thus ionization may occur when the change in kinetic energy of the ions is small compared to the ionization potential. (auth)

29944 ELECTROMAGNETICS AND FLUID DYNAMICS OF GASEOUS PLASMA. Proceedings of the Symposium, New York, N. Y., April 4, 5, 6, 1961. Microwave Research Institute Symposia Series. Volume XI. Brooklyn, Polytechnic Press, 1962. 468p.

Twenty four papers are included; separate abstracts have been prepared for 19. Five papers were previously abstracted in NSA. (T.F.H.)

29945 IS AERODYNAMICS BREAKING AN IONIC BARRIER? Adolf Busemann (NASA Langley Research Center, Langley Field, Va.). p.1-18 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The change of flow behavior at the speed of sound and the melting of materials by heat are both distinct and crucial effects, whereas the ionization of the air resembles, to a certain extent, dissociation and other changes of the air molecule, and should not change the mechanical flow reactions themselves in any special way. Radio communication can, however, become impossible when an aircraft surrounds itself with a Faraday cage composed of ionized air, and communication is generally accepted as a vital accessory to high-speed flight. Fear of ionization would therefore establish a barrier for the development of flight. Magnetofluiddynamics, on the other hand, reveals methods to direct ionized gases. This ionization problem is analyzed, and estimates of the practical importance of an extended flight within the specific speed and altitude regime for ionization are given. (auth)

29946 LINEAR WAVE PHENOMENA IN COLLISION-FREE PLASMAS. Ira B. Bernstein (Princeton Univ., N. J.). p.19-30 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

A survey of the theory of propagation of small-amplitude waves in plasmas is presented. The structure and significance of those models that can be most successfully analyzed are discussed, and certain classes of waves are described. (auth)

29947 AMPLIFICATION OF MICROWAVES BY MEANS OF PLASMA. Z. S. Chernov and G. A. Bernashevski (Inst. of Radioelectricity and Electronics, Academy of Sciences, USSR). p.31-5 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The interactions of a microwave-modulated electron beam with a plasma produced by an electric discharge in Hg are studied. At a given plasma current the gain is a function of the frequency of the signal. The frequency at which maximum gain occurs is found to be proportional to (plasma current density)$^{\frac{1}{2}}$. The noise characteristics of the plasma-amplified signals are investigated as functions of the discharge pressure. (T.F.H.)

29948 CONCERNING A CONTINUUM THEORY OF THE ELECTRODYNAMICS AND DYNAMICS OF MOVING MEDIA. Sydney Goldstein (Harvard Univ., Cambridge, Mass.). p.65-80 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

A discussion of the Minkowski theory of the electrodynamics of moving media is presented. The Maxwell and mechanical stress tensors, electromagnetic momentum, and angular momentum are discussed. Magnetohydrodynamic consequences, simple examples, and the results of experiments are discussed. (auth)

29949 STABILITY ANALYSIS OF PLASMAS BY A MODIFIED HYDROMAGNETIC THEORY. O. Buneman (Stanford Univ., Calif.). p.99-109 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Hot plasmas carrying high currents can be confined to dimensions much smaller than the mean free path. Hydromagnetic theory employing a scalar pressure and a scalar conductivity is thus of dubious value. A two-component theory (separate electron and ion fluids) with two pressure tensors following fully adiabatic laws can be justified by the moment method for supersonically propagating phenomena. Only a damping process is missing from this theory, which therefore errs on the pessimistic side when used for stability tests. The one-dimensionally confined plasma current sheet is subjected to a stability test by this method. Two-stream instabilities, gyromagnetic resonances, and hydromagnetic instabilities could occur, but it appears that all can be suppressed. (auth)

29950 TWO-STREAM INSTABILITIES WITH COLLISIONS. D. A. Tidman and George Weiss (Univ. of Maryland, College Park). p.111-19 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The effect of electron scattering on the two-stream instability that occurs in a plasma of contrastreaming electrons and ions is studied. This analysis is made by assuming that electron-ion collision frequency is small and making a perturbation expansion in this quantity. (auth)

29951 INTERACTION OF MICROWAVES IN GASEOUS PLASMAS IMMERSED IN MAGNETIC FIELDS. L. Goldstein, K. V. Narasinga Rao, and J. T. Verdeyen (Univ. of Illinois, Urbana). p.121-51 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The phenomenon of radiofrequency electromagnetic-

wave interaction in gaseous plasmas is reviewed. The application of microwave interaction to the study of plasmas immersed in magnetic fields is discussed. Attention is focused on the effects produced in such plasmas when one of the simultaneously propagating microwaves is at the electron cyclotron resonance. It is demonstrated that, for relatively modest amplitudes of the resonating wave, the kinetic energy of the electrons increases considerably, which in turn affects the electron collision frequency and the magnetic field control of the plasma confinement. (auth)

29952 EXCITATION OF PLASMA WAVES BY A DIPOLE IN A HOMOGENEOUS ISOTROPIC PLASMA. A. Hessel and J. Shmoys (Polytechnic Inst., Brooklyn). p.173-83 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The excitation of electromagnetic and acoustic waves by an oscillating point current element in a compressible plasma of infinite extent is investigated. The use of suitable potentials permits the separation of the fields into optical-wave and plasma-wave contributions. The far-field radiation pattern is unaffected by the presence of the plasma. The acoustic wave has maxima of radiation along the axis of the dipole. The ratio of power carried by the acoustic wave to that carried by the optical wave is found to be proportional to the cube of the ratio of velocity of electromagnetic waves in free space to the sound velocity in the electron gas. This large ratio is obtained because Debye shielding of the dipole is not taken into account. (auth)

29953 ON A VARIATIONAL PRINCIPLE FOR PLASMAS. S. Gartenhaus (Purdue Univ., Lafayette, Ind.). p.185-94 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

By making use of certain properties of Liouville's equation for a classical many-particle system, a mathematical correspondence is set up between this equation and that of Schrödinger. This similarity is then employed to set up, for the classical system, a variational principle that is the exact counterpart of the time-dependent Hartree-Fock method in the quantum-mechanical case. For practical applications, the variational principle requires the specification of a trial function whose form, however, is completely arbitrary. In particular, a trial function consisting of a product of single-particle functions yields directly the collisionless Boltzmann equation with the electromagnetic field terms determined in the self-consistent way. The problem of short-range correlations is discussed, and it is found that with the aid of a particular trial function that only a Maxwellian velocity distribution corresponds to equilibrium. (auth)

29954 POWER AND ENERGY RELATIONS IN BIDIRECTIONAL WAVEGUIDES. Paul Chorney (Massachusetts Inst. of Tech., Cambridge). p.195-210 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

General theorems on the propagation properties of a certain broad class of lossless, passive, uniform waveguides are developed. This class is referred to as "bidirectional." Two important cases of bidirectional waveguides are those containing isotropic materials, and those containing gyrotropic materials with the gyrotropic axis along the waveguide axis. A feature of the materials considered is that they are, in general, dispersive. The theorems interrelate group velocity, phase velocity, power, energy, and "pseudo energy." The term "pseudo energy" is used to distinguish the true energy from the energy-like terms that appear in the complex form of Poynting's theorem; for the case of dispersive media, true energy does not appear as such in the complex form of Poynting's theorem. As an illustration, these theorems are applied to the plasma-filled waveguide. Some general properties of the dispersion character are revealed. (auth)

29955 INTERACTION BETWEEN MAGNETIC FIELDS AND MOVING PLASMAS. W. H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). p.211-48 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Experimental results and theoretical descriptive models are given for various configurations where plasmas move in magnetic fields, with or without a background conducting medium. Constant velocity, accelerated motion, and flute-type instabilities are discussed. (auth)

29956 THEORY AND EXPERIMENTS FOR THE ROLE OF SPACE-CHARGE IN PLASMA ACCELERATION. R. V. Hess, J. Burlock, J. R. Sevier, and P. Brockman (NASA, Langley Research Center, Langley Field, Va.). p.269-305 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The role of space charge in plasma acceleration is discussed for a variety of accelerator designs. It is shown that the effects of space charges and eddy currents are coupled to each other, and the effects on plasma acceleration are discussed. Experimental studies of a coaxial plasma acceleration device reveal the role of space charges in building up oscillations and extra diffusion mechanisms. The possible role of space charge in obtaining electron emission from cathodes above the thermionic level without arc spots is experimentally demonstrated for the so-called hollow-cathode configuration. (auth)

29957 PRELIMINARY EXPERIMENTS OF MHD CHANNEL FLOW WITH SLIGHTLY IONIZED GASES. G. W. Sutton and F. Robben (General Electric Co., Philadelphia). p.307-21 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

An apparatus is constructed and operated for the study of magnetohydrodynamic flows and power generation with slightly ionized gases in a channel in an external magnetic field. The source of the plasma is a 2500-kw plasma jet, with nitrogen as the working fluid. Ionization is provided by the injection of powdered potassium carbonate downstream of the arc. The gases then flow through a rectangular channel, $\frac{5}{8} \times 4 \times 24$ in. long, with a constant transverse magnetic field of 10 kOe. On each narrow side of the channel are four electrodes; each pair of electrodes is switched through four resistances. The measured quantities yield data on the flow velocity and plasma electrical conductivity that compare favorably with theoretical calculations based on compressible flow with a turbulent boundary layer and variable conductivity. A maximum power of 6 kw and a maximum voltage of 78 volts open-circuit is obtained. (auth)

29958 MAGNETICALLY DRIVEN SHOCK WAVES. J. D. Cole and C. Greifinger (California Inst. of Tech., Pasadena and RAND Corp., Santa Monica, Calif.). p.347-61 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Several problems in the theory of magnetically driven shock waves are considered, and comparison is made with experiments. A linear accelerator in which the gas is driven down a coaxial tube by radial currents is studied. By the use of snowplow theory for the gas motion, the

coupled electric circuit and gas motion equations are solved. A diverging cylindrical shock wave is also considered that is produced by a line current increasing linearly with time (inverse pinch machine). The flow is computed both according to snowplow theory and using the full magnetohydrodynamic equations for an infinitely conducting gas, with and without initial constant magnetic field. A converging cylindrical shock wave is studied that is produced by a circumferential current (Scylla). For the case of constant current the snowplow approximation provides a simple solution. (auth)

29959 SOME PARADOXES OF SUB-ALFVENIC FLOW OF A COMPRESSIBLE CONDUCTING FLUID. W. R. Sears (Cornell Univ., Ithaca, N. Y.). p.363-71 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Steady magnetogasdynamic flows in the category called "aligned-field flows" may be classified as sub-Alfvenic or super-Alfvenic when the flow speed is respectively less or greater than the Alfven-wave speed. For plane or axisymmetric sub-Alfvenic flow of a perfectly conducting gas, there are both elliptic and hyperbolic regimes in both the subsonic and supersonic speed ranges. It is shown that these are consequences of the anisotropic propagation properties of magnetosonic waves. One result is a possibility of smooth transition directly from elliptic to hypercritical flow at points in the flow field. Some examples illustrating this phenomenon are shown. An apparent paradox is posed by supersonic-elliptic flow; it is conjectured that this paradox must be resolved by introduction of magnetogasdynamic shock waves, and some possible flow patterns are sketched. (auth)

29960 OBLIQUE SHOCK WAVES IN STEADY TWO-DIMENSIONAL HYDROMAGNETIC FLOW. Jack Bazer (New York Univ., New York) and W. B. Ericson. p.387-414 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

A method is presented for determining the orientation and strength of oblique shock waves in steady two-dimensional (planar) hydromagnetic flow. The medium is assumed to be an infinitely conducting, nonviscous, ideal polytropic gas. The method employs the hypotheses that the velocities relative to the shock, the excess density ratio, excess pressure ratio, etc., can be expressed as simple algebraic functions of the magnitude of the jump in magnetic field across the shock (h), and the angle (ω) that the shock makes with the upstream field. Attention is focused chiefly on the aligned-fields case where the results are especially easy to assess and are directly applicable to problems involving flow around wedges and corners. In this case the ranges for the slow and fast shock angles are easily delimited in terms of the turning angle and the upstream sound-to-Alfven-speed ratio. Moreover, the dependence of ω on h, and hence of all the characteristics of the downstream flow on h, are readily determined in terms of the characteristics of the upstream flow. (auth)

29961 ELECTROMAGNETIC DIFFUSION INTO A CYLINDRICAL PLASMA COLUMN. Joseph L. Neuringer, Lester Kraus, and Herbert Malamud (Republic Aviation Corp., Farmingdale, N. Y.). p.415-41 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

The diffusion of electromagnetic energy into a cylindrical plasma column produced by the discharge of the energy stored in a capacitor is formulated, taking into account the effects of the capacitance and inductance of the discharge circuit. The discharge circuit reflects the linear pinch geometry, in that the energy source is a charged condenser and the return lead is a perfectly conducting cylindrical shell concentric with and surrounding the plasma column. The plasma properties enter the formulation through an extended Ohm's law that includes the time rate of change of current density. Under the assumption that changes in the ionization density and collision frequency may be neglected, Maxwell's equations lead to a third-order linear partial differential equation for the diffusion current. An exact solution is obtained by Laplace transform techniques, using appropriate initial and boundary conditions that take into account the finite external circuitry. The spatial and temporal behavior of the current density distribution as a function of the parameters that characterize both the circuit and the plasma is discussed and compared with that of an ordinary conductor obeying Ohm's law. (auth)

29962 MAGNETOHYDRODYNAMIC SHOCK WAVES IN LOW-DENSITY IONIZED GAS. R. Z. Sagdeev (Kurchatov Inst., USSR). p.443-50 of "Electromagnetics and Fluid Dynamics of Gaseous Plasma." Brooklyn, Polytechnic Press, 1962.

Several types of plasma instabilities that occur within shock fronts of collision-free shock waves in rarefied plasma are studied. It is assumed that the plasma pressure is much less than the magnetic field pressure. (T.F.H.)

Shielding

29963 (NP-11958) [APPENDIX TO] TRANSMISSION OF SCATTERED GAMMA RAYS THROUGH CONCRETE AND IRON SLABS. Reprint of TO-B 59-13. Dominic J. Raso (Technical Operations, Inc., Burlington, Mass.). Dec. 14, 1961. 55p.

The text of this report has been published in Health Phys., 5: 126-41(June 1961).

Tables are presented showing the transmission of gamma radiation through concrete and iron. (N.W.R.)

29964 (UCRL-9970) EARTH MATERIALS FOR LOW-BACKGROUND RADIATION SHIELDING. Harold A. Wollenberg and Alan R. Smith (California. Univ., Berkeley. Lawrence Radiation Lab.). May 24, 1962. Contract W-7405-eng-48. 126p.

A search was conducted for materials for construction of a low-background counting-room enclosure. Gamma-ray spectrographic analyses of sources of concrete aggregates in Central California indicate that ultramafic rocks are best suited for use as low-background aggregates. It is expected that the background level to be achieved inside the enclosure will be one-hundredth that presently existing at the site. To achieve this, the counting-room enclosure must not only serve as a shield but also have inherently low radioactivity. Material with a gamma-ray spectrometer counting rate $\leq$0.004 counts/min-g would be adequate for this purpose. The principal contributors to the gamma-ray activity of most earth materials are U^{238}, Th^{232}, their decay products, and K^{40}. The U, Th, and K concentrations vary with the acidity of igneous rocks, being practically nil in the ultramafic rocks and highest in the igneous rocks. In carbonate rocks, U is the principal radioactive contaminant and is most abundant when carbonaceous material is present. In sediments, U and Th are concentrated with the heavy minerals: zircon, apatite, cassiterite, sphene, and rutile. Samples of possible sources of low-background aggregate were collected and

subjected to gamma-ray spectrographic analysis on a 100-channel analyzer. Total counting rate in counts per minute per gram and the individual contributions (in counts per minute) of U, Th, and K to the total gamma-ray spectrum were computed from data obtained for each sample. Standard Portland cement and concrete aggregate material obtained locally were found to be too radioactive to be suitable for low-background material. Local sand also contained too much radioactivity for use in low-background shielding. Contamination of low-background rocks is derived primarily from adjoining higher background rock and dikes intruding the deposits. Fall-out from Cs^{137} is a source of surface contamination on exposed material. Possible sources of low-background material that were examined included serpentinized ultramafic rocks in the Coast Ranges and Sierra Nevada foothills, the Calera, Calaveras, and Gabilan limestones and dolomites, vein and placer quartz of the Sierran foothills, barite deposits near Dutch Flat, California and Battle Mountain, Nevada, talc from the vicinity of Keeler, California, boron minerals from the Kramer area, California, and diatomite from Napa County. Recommended materials include freshly broken, serpentinized ultramafic rock from the Sonora area, dolomitic limestone from Salinas, and pure quartz from the Sierran foothills. (auth)

29965 (FTD-TT-62-832) THE PHYSICS OF SHIELDING. O. I. Leypunskii (Leypunskiy). Translated from Atomnaya Energ., 12: 216-29(Mar. 1962). 36p.

A discussion of the main problems associated with shielding is presented. Information is included on the determination of radiation fields, narrow-beam point-sources, optimum solutions for shielding design, the angular-spectral distribution of intensities and doses, albedos, non-steady multiple scattering, neutrons, the passage of high-energy particles through protective media, dosimetry, and radioactive contaminants from explosions and nuclear industrial wastes. Other discussions concerned with biological aspects of shielding are included. (J.R.D.)

29966 CONCRETE SHIELDING CONSTANTS. Richard L. Walker and Marshall Grotenhuis (Argonne National Lab., Ill.). Nucleonics, 20: No. 8, 141(Aug. 1962).

Shielding constants are tabulated for 8 representative concretes. The constants presented are neutron constants, total gamma linear attenuation coefficients, thermal-neutron-capture gamma spectra, and gamma energy-absorption linear attenuation coefficients. The constants were calculated on the assumption that the cross section of a mixture is the sum of the cross sections of the constituent elements, except water. (D.L.C.)

29967 RADIATION SHIELDING AGAINST FALLOUT. Eric T. Clarke and James O. Buchanan (Technical Operations Research, Burlington, Mass.). Nucleonics, 20: No. 8, 143-6(Aug. 1962).

Data are presented which should be useful in evaluating the protection offered by various structures against gamma radiation emitted by early fallout from nuclear weapons and deposited on the ground. A % dose vs time graph is given for 11 energy intervals covering the range 0.29 to 3.7 Mev. The decay of fallout gamma radiation and dose rate above infinite-plane sources are discussed. The three basic configurations of protective structures are described. Mass thicknesses in lb/ft^2 are tabulated for nominal thicknesses of structural materials. Buildup factors for radiation scattered in the medium are discussed and tabulated. (D.L.C.)

29968 ZASHCHITA OT IZLUCHENIYA PROTYAZHENNYKH ISTOCHNIKOV. (Radiation Protection from Extended Sources). N. S. Gusev, E. E. Kovalev, D. P. Osanov, and V. I. Popov. Moscow, Gosatomizdat, 1961. 287p.

Protection against extended radiation sources is discussed. Equations were developed for determining the yield and weak emission from extended sources, considering geometry, self-absorption, and attenuation from arbitrary or given points. The numerical results were programmed for a computer and are presented as extended source functions. 46 references are included. (R.V.J.)

Theoretical Physics

29969 THE LORENTZ-EINSTEIN TRANSFORMATION OBTAINED BY A VECTOR METHOD. Gérard Nadeau (Laval Univ., Quebec). Am. J. Phys., 30: 602-3(Aug. 1962).

Two systems of coordinates are considered, one traveling rectilinearly with a velocity v with respect to the other, such that their origins coincide at the zero of time. A linear vector-type transformation is found relating the position vectors and times in the two systems, which reduces to the Galilean transformation if $v = 0$. This vector transformation reproduces the Einstein-Lorentz transformation. (T.F.H.)

29970 ON CLASSICAL COULOMB SCATTERING. Gérard Nadeau (Laval Univ., Quebec). Am. J. Phys., 30: 654-5(Sept. 1962).

By vector analysis of the classical scattering of particles by a central Coulomb field, it is found that there exist families of surfaces orthogonal to the scattered-particle trajectories. These surfaces are given the name "wave surfaces," and it is found that at large distances from the scattering center the asymptotic behavior of the incoming and outgoing wave surfaces completely agrees with that of the respective quantum-mechanical wave surfaces. (T.F.H.)

29971 UTILIZATION OF THE DENSITY OPERATOR FOR THE DETERMINATION OF THE EIGENENERGIES AND EIGENFUNCTIONS OF A CANONICAL GROUP. Pierre Smet and Jacques Tillieu (Institut de Physique, Faculte des Sciences, Lille, France). J. phys. radium, 23: 299-304(May 1962). (In French)

Two methods are indicated for obtaining eigenenergies and corresponding projectors of a closed quantum system from the density operator describing this system in thermodynamic equilibrium and considered as a solution of Bloch's equation. The first method uses the limit of null temperatures; the second one, the properties of Laplace's transform. The harmonic oscillator is treated as example. (auth)

29972 EXPANSIONS OF COULOMB WAVE FUNCTIONS IN TERMS OF BESSEL FUNCTIONS. A. S. Meligy and E. M. El Gazzy (Univ. of Alexandria, Egypt). Nuclear Phys., 36: 642-7(Aug. 1962). (In English)

Analytic expansions of both regular and irregular Coulomb functions in terms of spherical Bessel functions are given. They are convenient for the computation of the wave functions for particles of high energies. (auth)

29973 GENERATORS OF COORDINATE TRANSFORMATIONS IN THE PENROSE FORMALISM OF GENERAL RELATIVITY. Arthur Komar (Syracuse Univ., N. Y.). Phys. Rev., 127: 955-9(Aug. 1, 1962).

A new covariant expression for the generator of coordinate transformations is developed in the general theory of relativity. It is hoped that this expression may facilitate the determination of the commutation relations between the independent dynamical variables of Penrose. Since the Penrose function is defined on a characteristic surface, a

program for quantization is discussed which can be applied to dynamical variables defined on such null surfaces. In addition, the relationship of the new conservation law to the usual physical constants of Lorentz-covariant theories is indicated, the relationship being effected when there exists a Killing bivector in the Riemannian manifold. (auth)

29974 TWO-PARAMETER STATISTICAL MODEL. George R. Kalbfleisch (Univ. of California, Berkeley). Phys. Rev., 127: 971-3(Aug. 1, 1962). (UCRL-10024)

A statistical model is described which empirically relates the volume (characterized by λ_i) associated with each particle to its mass (m_i). The functional dependence used in $m_i^2\lambda_i = \text{const}$, where α is some constant. The two parameters λ_π and α, in addition to the masses m_i, determine all the other λ_i. The model is applied to antiproton-proton annihilation at low and moderate energies. The annihilation is assumed to proceed through all possible intermediate states consisting of all combinations of the five mesons, π, K (or $\bar{K}$), K* (or $\bar{K}^*$), ρ, and ω. The experimental multiplicities and fraction of $K\bar{K}m\pi$ (m = 0, 1, 2, ...) states determine the two parameters λ_π and α to be 4.0 ± 0.4 and 1.94 ± 0.06, respectively. These values of λ_π and α predict the extent to which the K* (or $\bar{K}^*$), ρ, and ω take part in the annihilation. These predictions are found to be in reasonable agreement with recent experimental data on the role of the K* (or $\bar{K}^*$), ρ, and ω in $\bar{p}p$ annihilation. The η meson is also considered. (auth)

29975 COMPLEX ANGULAR MOMENTUM IN RELATIVISTIC S-MATRIX THEORY. A. O. Barut and D. E. Zwanziger (Univ. of California, Berkeley). Phys. Rev., 127: 974-7(Aug. 1, 1962).

On the basis of unitarity and the Mandelstam representation, the analyticity and threshold behavior of the positions and residues of the poles of the scattering amplitude in angular momentum as a function of energy are discussed. The right and left cuts of the partial wave amplitude for complex l are separated, and, in a model theory in which elastic unitarity holds, the domain of analyticity in the l plane is extended to the region Re$l > 1$. (auth)

29976 RATE DIFFERENCE BETWEEN A CLOCK IN AN ARTIFICIAL SATELLITE AND A CLOCK ON THE EARTH. Sjur Refsdal (Univ. of Oslo, Blindern, Norway). Phys. Rev., 127: 977-8(Aug. 1, 1962).

Taking account of the diurnal rotation and the oblateness of the earth, the average relative rate difference is calculated for an arbitrary inclination of the satellite orbit. For eccentricities less than 0.1, an accuracy of order 10^{-14} is obtained. (auth)

29977 DISSIPATIVE POTENTIALS AND THE MOTION OF A CLASSICAL CHARGE. Boris Leaf (Kansas State Univ., Manhattan). Phys. Rev., 127: 1369-76(Aug. 15, 1962).

The equation of motion of a charge is obtained as a second-order integro-differential equation, directly from Maxwell's field equations and Lorentz's force equation without the use of the Dirac equation of motion. The validity of the field equations is assumed everywhere, the position of the charge being treated as a point singularity. The force on the charge at the field point is given by the expression for the Lorentz force produced by the fields of a source charge in the limiting case where the field charge is identified with the source. The only fields which need to be considered are the retarded solutions of the field equations in agreement with causality. In order to obtain the equation of motion, it is necessary to formulate the potentials of the field of a point source in dissipative form. In this form, the potentials satisfy the Lorentz gauge condition identically. They are Fourier integrals which contain δ_s functions in the Fourier coefficients. When the equation of motion is applied to the examples of relativistic motion of a free charge and to the nonrelativistic simple harmonic motion of a charge, it is found that the principal-part terms of the δ_s functions provide the electromagnetic kinetic reaction, while the δ function terms provide the dissipative effects. The only divergence stems from the principal-part integrals, and is the Coulomb self-energy of the charge. It can be removed by renormalization of mass. The results are consistent with the Abraham theory that the mass of an electron (and positron) is wholly electromagnetic. (auth)

29978 FUNDAMENTAL PROPERTIES OF PERTURBATION-THEORETICAL INTEGRAL REPRESENTATIONS. Noboru Nakanishi (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 127: 1380-7(Aug. 15, 1962).

The integral representations proposed previously are extended to the case of general transition amplitudes. The analyticity domain of any term in these representations is found explicitly. It is proved that any function analytic in this domain has an integral representation of the above type and then the weight function in this representation is uniquely determined. It is also proved in the case of two-particle scattering that the amplitude uniquely determines the three weight functions in its integral representation if they satisfy certain conditions. (auth)

29979 FACTORIZATION OF THE RESIDUES OF REGGE POLES. John M. Charap and Euan J. Squires (Univ. of California, Berkeley). Phys. Rev., 127: 1387-8(Aug. 15, 1962). (UCRL-10115)

A proof of the factorizability of the residues of Regge poles, valid for a many-channel potential scattering problem, is given. Unitarity and certain other plausible assumptions about the S matrix allow the proof to be extended to the relativistic S-matrix theory. (auth)

29980 SELF-CONSISTENT APPROXIMATIONS IN MANY-BODY SYSTEMS. Gordon Baym (Univ. of Copenhagen). Phys. Rev., 127: 1391-1401(Aug. 15, 1962).

The criteria for maintenance of the macroscopic conservation laws of number, momentum, and energy by approximate two-particle correlation functions in many-body systems are investigated. The methods of generating such approximations are the same as in a previous paper. However, the derivations of the conservation laws given here clarify both why the approximation method works and the connection between the macroscopic conservation laws and those at the vertices. Conserving nonequilibrium approximations are based on self-consistent approximations to the one-particle Green's function. The same condition that ensures that the nonequilibrium theory be conserving also ensures that the equilibrium approximation has the following properties. The several common methods for determining the partition function from the one-particle Green's function all lead to the same result. When applied to a zero-temperature normal fermion system, the approximation procedure maintains the Hugenholtz-Van Hove theorem. Consequently, the self-consistent version of Brueckner's nuclear matter theory obeys this theorem. (auth)

29981 APPROACH TO EQUILIBRIUM OF QUANTUM MECHANICAL GIBBSIAN ENSEMBLES. Charles R. Willis (Boston Univ.). Phys. Rev., 127: 1405-10(Aug. 15, 1962).

The approach to equilibrium of an arbitrary physical system in contact with a thermal reservoir is described when the internal dynamics of the system is described by its Hamiltonian and the interaction with the reservoir can be described by a linear stochastic kernel which in general can

be time dependent. A generalization of the Markov process represented by the master equation to the space of density matrices is found, and it is proved that the necessary and sufficient condition that any solution of an equation of the general structure approach equilibrium monotonically is that equilibrium is a stationary solution. It is also proved that the Helmholtz free energy is a minimum as a functional of the density matrix and thus is a suitable measure of deviation from canonicity. Another measure of deviation is found which is equally good and easier to use. It is shown, as an example, that Bloch's microscopic density matrices fulfill the criteria and thus approach equilibrium monotonically. Finally, the results for the thermal reservoir are extended to more general reservoirs. (auth)

29982 ASYMPTOTIC COVARIANT CONSERVATION LAWS FOR GRAVITATIONAL RADIATION. Arthur Komar (Syracuse Univ., N. Y.). Phys. Rev., 127: 1411-18(Aug. 15, 1962).

The usual conserved quantities of Lorentz-covariant theories are associated with the descriptors of coordinate transformations in Killing directions. By suitably defining the concept of asymptotic-Killing vector fields, it is possible to extend the definition of the usual conserved quantities to situations in which, properly speaking there are no Killing vector fields, but in which, nevertheless, it is still meaningful to speak of the energy, momentum and perhaps angular momentum radiated by the gravitational field. Among the results obtained in the course of the investigation are: (a) an understanding of the circumstance which singles out the energy as a positive-definite quantity; (b) a possible global consequence that vanishing energy implies that the space is flat; (c) an understanding of the position of the Fock harmonic coordinate conditions in Trautman's treatment of gravitational radiation; (d) an extension of the validity of the Møller pseudotensor to the Trautman radiative solutions. Also a brief indication is given of how this work might be extended to give a proper treatment of energy, momentum, and angular momentum densities for general metrics. (auth)

29983 GRAVITATIONAL WAVES IN GENERAL RELATIVITY. VII. WAVES FROM AXI-SYMMETRIC ISOLATED SYSTEMS. H. Bondi, M. G. J. van der Burg, and A. W. K. Metzner. Proc. Roy. Soc. (London), A, 269: 21-52(Aug. 21, 1962).

Some general considerations about gravitational radiation are followed by a treatment of the scalar wave equation in a manner later to be applied to Einstein's field equations. A co-ordinate system is specified that is suitable for investigation of outgoing gravitational waves from an isolated axi-symmetric reflection-symmetric system. The metric is expanded in negative powers of a suitably defined radial co-ordinate r, and the vacuum field equations are investigated in detail. It is shown that the flow of information to infinity is controlled by a single function of two variables called the news function. Together with initial conditions specified on a light cone, this function fully defines the behavior of the system. No constraints of any kind are encountered. The transformations leaving the metric in the chosen form are determined. An investigation of the corresponding transformations in Minkowski space suggests that no generality is lost by assuming that the transformations, like the metric, may be expanded in negative powers of r. The mass of the system is defined in a way that in static metrics agrees with the usual definition. The principal result of the paper is then deduced, namely, that the mass of a system is constant if and only if there is no news; if there is news, the mass decreases monotonically so long as it continues. The linear approximation is next discussed, chiefly for its heuristic value, and employed in the analysis of a receiver for gravitational waves. Sandwich waves are constructed, and certain non-radiative but non-static solutions are discussed. A tentative classification is made of time-dependent solutions of the types considered. (auth)

29984 ON THE RADIATION FIELD OF PULSE SOLUTIONS OF THE WAVE EQUATION. F. G. Friedlander (Cambridge Univ., Eng.). Proc. Roy. Soc. (London), A, 269: 53-65(Aug. 21, 1962).

The wave equation $u_{tt} - \Delta u = 0$ can be satisfied formally by series expansions in descending powers of r whose coefficients are functions of θ, ϕ and $t - r$, where r, θ, and ϕ are polar coordinates. For such a solution, $u \sim r^{-1} f(\theta, \phi, t - r)$ as $r \to \infty$. If a simple boundary condition, such as $u = 0$ for $t = r$, is imposed on u, then the coefficients of the formal series expansion are completely determined by f. Taking this heuristic consideration as a point of departure, solutions u of the wave equation that are defined in the exterior of a fixed sphere $r = a$, for $t > r$, and that vanish when $t = r$, are studied. It is shown that the limit $f(\theta, \phi, r) = \lim(r \to \infty) [ru(r, \theta, \phi, r + \tau)]$ then exists for $\tau > 0$, and that $f \equiv 0$ implies that $u \equiv 0$ in $t > r > a$, so that such a solution is uniquely determined by its "radiation field" f. It is further shown that when f is a regular analytic function of θ and ϕ on the unit sphere, then the formal series expansion converges when $|t - r|/|r|$ is sufficiently small. Finally, it is shown that when f is independent of ϕ (axial symmetry) and an analytic function of $\cos \theta$, then u can be expressed in terms of f by means of a simple integral representation. (auth)

29985 QUASI-CLASSICAL WAVE FUNCTION OF A SYSTEM WITH MANY DEGREES OF FREEDOM. A. V. Chaplik (Inst. of Radiophysics and Electronics, Siberian Department of the Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 84-6(July 1962). (In Russian)

An approximate expression is presented for the quasi-classical wave function of a system with many degrees of freedom. The result obtained is valid in a broader range than is that obtained by perturbation theory. (auth)

29986 FORMULA FOR CALCULATION OF PHASE SHIFTS IN CASE OF THOMAS-FERMI AND HARTREE POTENTIALS. T. Tietz and L. Voicheck (L. Wojtczak) (Inst. of Theoretical Physics at Lodz Univ., Poland). Zhur. Eksptl'. i Teoret. Fiz., 43: 87-8(July 1962). (In Russian)

A formula for phase shifts is deduced for small orbital momentum values. The formula is in a convenient form for calculations. (auth)

29987 ON DYNAMIC RESONANCES IN SOLUTIONS OF THE LOW EQUATION FOR SOME FIELD THEORY MODELS. B. M. Barbashov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 105-11(July 1962). (In Russian)

The possibility of existence of dynamic resonances in the solutions of the Low equation for some renormalized and nonrenormalized field theory models is analyzed. It is shown that the constraints on the coupling constant imposed by the condition of analyticity of the amplitude precludes the appearance of dynamic resonances in the renormalized cases. The behavior of the S phase shift in the nonrenormalized model of scalar charged mesons is similar to that of the P phase shift in the Chew–Low model. (auth)

29988 ON SOLVING EQUATIONS OF THE CHEW-MANDELSTAM TYPE. N. Meyman and I. Gokhfeld (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 181-4 (July 1962). (In Russian)

It is shown that the Chew–Mandelstam equation for the interaction amplitude of neutral mesons has a solution that does not oscillate at infinity only in cases that do not have a physical meaning, i.e., when the coupling constant is negative. This result can be obtained from some very general properties of analytic functions. (auth)

29989 ON EXPERIMENTAL VERIFICATION OF UNITARY SYMMETRY OF STRONG INTERACTIONS. V. M. Shekhter (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 43: 205-15(July 1962). (In Russian)

The possibilities of an experimental verification of the unitary symmetry of strong interactions are discussed. For this purpose the relations between the amplitudes of various processes are established for each of the two unitary symmetry variants. (auth)

29990 QUANTUM FIELD THEORY IN CONSTANT CURVATURE p-SPACE. Yu. A. Golfand (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 43: 256-67(July 1962). (In Russian)

A quantum field theory apparatus in constant-curvature p-space is proposed, which permits calculation of the matrix elements of any process. The theory is formulated in elliptic p-space; this corresponds to the "Euclidian" formulation of the theory. All expressions encountered in the theory are finite. The Schwinger equation for the Green's function is generalized. Some features of the theory connected with noncommutivity of the displacement operator in constant-curvature space are considered. (auth)

29991 ON SOLVING OF THE DISPERSION METHOD LINEAR EQUATIONS IN THE TWO-PARTICLE APPROXIMATION. A. F. Grashin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl' i. Teoret. Fiz., 43: 277-86(July 1962). (In Russian)

A method is proposed for solving the linear integral equations that arise when the effect of nearest singularities is calculated by the dispersion technique (two-meson approximation). It is shown that in this case only one solution can be obtained in the low-energy region that does not depend on the behavior of the amplitude under consideration at infinity. This behavior is defined by a number of mass states in the unitarity condition (distant singularities). The condition of independence on the behavior in the high energy region which is equivalent to the requirement of stability with respect to disturbances at infinity, is a necessary condition for solution of the problem, and ensures uniqueness of the solution. Ambiguity is shown to result from an additional family of solutions, which are unstable against perturbations at infinity and have no meaning in the given problem. The methods proposed for calculating $\pi\pi$ interaction effects are based on application of unstable solutions and in general lead to erroneous results. An analysis is carried out for the simplest amplitude, the π meson electromagnetic form factor. (auth)

29992 ON SOME PROPERTIES OF HIGH ENERGY ELASTIC SCATTERING AMPLITUDE. V. N. Gribov and I. Ya. Pomeranchuk (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 43: 308-18(July 1962). (In Russian)

It is shown that the imaginary part of the scattering amplitude $A_1(s,t)$, in the channel in which s is the energy in the nonphysical region of transferred momenta $t > 0$, is positive and possesses all derivatives with respect to t which are greater than zero up to the first singularity defined by the Landau curve $t = t_0(s)$. It follows that in this t interval $dl/dt > 0$ for the Regge pole with the largest Re l. A proof is presented that for $t > 4\mu^2$, $l(t)$ in the l plane goes over to the upper half-plane. These results are obtained without assuming the existence of an Hamiltonian. Various possible dependences of l on t for $t \to \infty$ are discussed. The problem as to whether the poles corresponding to "elementary particles" are continuous functions of l is discussed. It is demonstrated that in the calculation of the spectral density $\rho(s,t)$ the condition for neglecting all singularities in the l-plane except the pole with a maximum Re l is that $(t-4\mu^2) \gg \mu^4$. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 29092, 29232, 29244, and 29330.

29993 (AE-72) ONE-GROUP PERTURBATION THEORY APPLIED TO SUBSTITUTION MEASUREMENTS WITH VOID. Rolf Persson (Aktiebolaget Atomenergi, Stockholm). June 1962. 24p.

Formulas suitable for evaluating substitution measurements or single-rod experiments by means of one-group perturbation theory are derived. The diffusion coefficient may depend on direction and position. By using the buckling concept, the perturbed flux can be taken into account in a comparatively simple way. By using an unconventional definition of cells, a transition region is introduced logically. Experiments with voids around metal rods were analyzed. The agreement between extrapolated and directly measured buckling values is excellent, the buckling difference between lattices with water-filled and voided shrouds being $0.263 \pm 0.015\ m^{-2}$, and $0.274 \pm 0.005\ m^{-2}$ respectively. The differences between diffusion coefficients are $\delta D_r/D = 0.083 \pm 0.004$, and $\delta D_z/D = 0.120 \pm 0.018$. (auth)

29994 (AEET/HP/3(Rev.)) RADIOACTIVITY BUILD-UP IN REACTOR COOLANT WATER. D. V. Gopinath (India. Atomic Energy Establishment, Trombay). 1961. 20p.

A theoretical evaluation of the built-up radioactivity in reactor coolant water was attempted. Expressions for the coolant activity for various cases in different cooling systems were derived. Tables for the characteristics of some of the major impurities in the coolant water and the activity buildup in the coolant by thermal neutron activation in some typical cases are presented. (auth)

29995 (AGN-TM-386) ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. TUBE BUNDLE REPLACEMENT IN THE GAS-COOLED REACTOR EXPERIMENT. R. H. Chesworth and J. M. Janis (Aerojet-General Nucleonics, San Ramon, Calif.). Sept. 1960. Contract AT (10-1)-880. 51p.

The GCRE was designed to utilize an insulated aluminum tube bundle to house the fuel elements. Preoperational testing, performed approximately 10 months after reactor vessel fabrication, revealed numerous leaks in the seal weld area at the junction of the pressure tubes and tube sheet. The decision was made to replace the aluminum tube bundle with a bundle fabricated from stainless steel. While the stainless steel tube bundle was being fabricated, the aluminum bundle was utilized to check out the reactor system and to perform a series of zero power tests. The stainless steel tube bundle was delivered in May 1960. Following zero power tests of the reactor, and thermal testing of the tube bundle, the reactor was successfully taken to power in July 1960. (auth)

29996 (ANL-6278) PULSED EDDY CURRENT INSTRUMENT FOR MEASURING SODIUM LEVELS OF EBR-II FUEL RODS. Kunio Ono and W. J. McGonnagle (Argonne National Lab., Ill.). July 1961. Contract W-31-109-eng-38. 24p.

A pulsed eddy current system with differential coil assembly was proved to be applicable to measure the sodium levels in EBR-II fuel rods with an accuracy better than ±0.030 in. When the sodium levels are flat or have only slight variations, a cylindrical coil system can be readily used. However, when the sodium levels vary around the periphery, the cylindrical system fails to measure the average sodium levels. A four-channel point-probe-type pulsed eddy current system was developed for this problem. With this equipment the sodium levels at four points on the periphery could be determined. The average value of these four measurements correlated with those determined by destructive tests. (M.C.G.)

29997 (ANL-6423) MULTIGROUP CALCULATIONS OF EFFECTIVE NEUTRON FRACTION β_{eff}, PROMPT NEUTRON LIFETIME l_p, AND RELATED KINETICS PARAMETERS FOR LARGE, FAST, PLUTONIUM-FUELED REACTORS. H. A. Sandmeier (Argonne National Lab., Ill.). Sept. 1961. Contract W-31-109-Eng-38. 22p.

Large, plutonium-fueled, fast reactors will have a different kinetic behavior than fast reactors fueled with U^{235}, due to the much smaller delayed-neutron fraction emitted in the fissioning of plutonium. The fissioning of Pu^{240}, Pu^{241}, Pu^{242}, and especially U^{238}, which emit more delayed neutrons per fission than Pu^{239}, introduces a considerable increase in β_{eff} over that for a hypothetical pure Pu^{239} reactor. The cases considered are 800-, 1500-, and 2500-liter cores fueled with plutonium of different isotopic content, which lead to effective delayed-neutron fractions of approximately one-half the values of similar U^{235}-U^{238}-fueled fast reactors. The energy spectrum and the number of fissions weighted with their importance are recorded in order to reason physically on the obtained parameters. (auth)

29998 (ANL-6581) A STUDY OF VAPOR CARRYUNDER AND ASSOCIATED PROBLEMS. Michael Petrick (Argonne National Lab., Ill.). July 1962. Contract W-31-109-eng-38. 117p.

A model for the carryunder phenomena is presented, and an analytical expression for the quality ratio X_D/X_R is derived. The dominating factor in this analysis is the definition of a specific area in the riser from which carryunder emanates. Data taken from an atmospheric air-water loop are compared with the predicted values for wt % carryunder for the parameter range studied ($0.2 \times 10^{-3} < x < 2.0 \times 10^{-3}$, 1 ft/sec $< V_D <$ 2.5 ft/sec). The proposed model proved successful, and good agreement between measured and calculated values was obtained. A dimensional analysis of the pertinent parameters affecting carryunder was also made, and a series of dimensionless groupings were derived. These groupings were then used to develop empirical correlations for predicting carryunder. The empirical correlation adequately represents a series of high-pressure data over the parameter range $0.1 < \alpha_R < 0.5$, $0.5 < V_D <$ 2.5 ft/sec, pressure = 600, 1000, 1500 psi, but the air-water data taken at atmospheric pressure deviate substantially. A nondimensionless empirical correlation, however, was developed for the X_D/X_R ratio, and the predicted values compared well with the data from both the atmospheric air-water and high-pressure loop. Fair agreement was obtained also with preliminary data taken with a large system (EBWR). Information necessary for the development or utilization of the proposed correlations is included in appendices on bubble-size distribution ($0.01 \times 10^{-3} < x < 2.0 \times 10^{-3}$, 0.9 ft/sec $< V_s <$ 2.8 ft/sec); bubble size versus bubble

velocity relationship; phase distributions within a conduit ($1.15 < V_s < 9.25$ ft/sec, $0.0004 < x < 0.004$); and downflow slip ratios (P = 600, 1000, and 1500 psi, $0.003 < x < 0.12$, 19 ft/sec $< V_s <$ 4.5 ft/sec). All data derived for the studies are tabulated. (auth)

29999 (APAE-Memo-311(Rev.1)) SPECIFICATIONS AND FABRICATION PROCEDURES FOR TYPE 3 FUEL ELEMENTS. E. C. Edgar and H. R. Clayton (Alco Products, Inc., Schenectady, N. Y.). Apr. 27, 1962. Contract AT(30-1)-2639. 119p.

Process and product requirements to be met in the fabrication of Type 3 fuel elements are presented. The fuel elements specified consist of thin plates of a dispersion of highly enriched UO_2 and ZrB_2 in a stainless steel matrix which is clad with stainless steel on all surfaces. Quality assurance provisions are discussed. Process and material specifications and packaging and packing for shipment are described. Sample calculations and drawings are included. (M.C.G.)

30000 (APAE-Memo-318) MATHEMATICAL ANALYSIS OF RIPPLING OF TYPE 1 FUEL PLATES. PART I. S. D. Beck and J. V. Miller (Alco Products, Inc., Schenectady, N. Y.). July 5, 1962. Contract AT(30-1)-2639. 53p.

Rippling phenomena due to heating in fuel plates of SM and PM type reactors are investigated analytically using small deflection theory of plates. Temperature variations across the width of the plate are accounted for. Detailed calculations are conducted for simply supported plates. It is found that within the limitations imposed by small deflection theory that the amplitude of the plate ripples induced by the heating is directly proportional to the initial amplitude. (auth)

30001 (APAE-Memo-322) CORRELATION OF CRITICAL MASS DATA ON LIGHT WATER MODERATED, FULLY ENRICHED URANIUM, STAINLESS STEEL REACTORS. PART I. D. H. Lee (Alco Products, Inc., Schenectady, N. Y.). July 17, 1962. Contract AT(30-1)-2639. 52p.

Experimental data were collected on over 70 light water moderated, fully enriched uranium, stainless steel, critical cores. An equation for the critical mass of cores with a buckling of 0.007 cm^{-2} that is lineally dependent on stainless steel volume fraction and grams of B^{10} was compared with available critical experiments and found to yield reasonable results. A correlation method, relating buckling to $(\xi\Sigma_a/\Sigma_s)$ was found to fit the available experiments. (auth)

30002 (APEX-616) INVESTIGATION OF A CORRUGATED SHELL AS AN ELASTIC SUPPORT OF A BUNDLE OF RODS. APPENDIX B: CORRUGATED SHELL ANALYSIS FOR A HIGH-TEMPERATURE-REACTOR RADIAL SUPPORT SYSTEM. J. H. Meier (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Apr. 14, 1961. For General Electric Co. Flight Propulsion Lab. Dept., Cincinnati. Contracts AF33(600)-38062 and AT(11-1)-171. 34p.

Application of knowledge and formulas developed in the report "Investigation of a Corrugated Shell as an Elastic Support for a Bundle of Rods" (APEX 615) to the D140E Reactor is discussed. The calculations are based on the design data for the D140E Reactor supported by leaf springs in a smooth shell and on the calculated profile of radial thermal differential expansion between the core and shell. (J.R.D.)

30003 (APEX-906) HEAT TRANSFER REACTOR EXPERIMENT NO. 3. Comprehensive Technical Report, General Electric Direct-Air-Cycle Aircraft Nuclear Propulsion Program. F. C. Linn—D. H. Culver, ed. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Contracts AF 33(600)-38062 and AT(11-1)-171. 206p.

The Heat Transfer Reactor Experiment No. 3 (HTRE No. 3), a solid-moderated nuclear power plant with a horizontal reactor, is described. The objectives and accomplishments of the program are presented in addition to nuclear, thermodynamic, and control system design data. The power plant and components, including the reactor, shield, turbomachinery, controls, and test support equipment are described, and the low-power and operational tests are discussed. Manufacturing techniques, component testing, and materials developments are also presented. The objective of the HTRE No. 3 program was to provide the technical information needed for the design of a ground test prototype power plant and to test methods of design analysis and performance prediction. (auth)

30004 (ARF-4267-1) STUDIES OF REACTOR CONTAINMENT. Bi-Monthly Progress Report, May-June 1962. P. Lieberman (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Contract AT(11-1)-578. 26p.

Research progress is reported on crushable shield analysis and design, shock crushing of reactor shield materials, and coolant decompression experiments and analysis. (M.C.G.)

30005 (ARF-8262-1) STUDIES OF REACTOR CONTAINMENT STRUCTURES. Bi-Monthly Progress Report, May-June 1962. N. A. Weil, R. L. Chiapetta, C. J. Costantino, P. G. Hodge, S. A. Morse, and M. A. Salmon (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 16, 1962. Contract AT(11-1)-578. 42p.

In the program for analysis of containment vessel response in the range approaching failure, an approximate analysis method was used for application to the solution of cylinders with rigid bases and hemispherical heads. The solution for approximate burst strength is included. Work was also directed toward understanding of the effects of attachments and cutouts in containment vessels on the plastic behavior and bursting strength of these structures. Progress during the period is reported on a literature review, and an analysis of openings on plastic behavior of plates. In other work, design activities for an experimental investigation concerning the behavior of thin cylindrical shells with rigid caps when subjected to a series of incrementally increasing internal pressure is reported along with similar investigations concerning complete pressure vessels. Development effort on a containment handbook is also outlined. (J.R.D.)

30006 (BAW-1250) SPECTRAL SHIFT CONTROL REACTOR—BASIC PHYSICS PROGRAM. Quarterly Technical Report No. 6, January-March 1962. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Contract AT(30-1)-2602. 80p.

The work performed under the Spectral Shift Control Reactor Basic Physics Program during the sixth contract quarter is summarized. The major objective of this program is to determine basic nuclear parameters of lightly packed lattices of slightly enriched fuels moderated with D_2O-H_2O mixtures. The final results of exponential experiments at elevated temperatures, performed during the preceding quarter, are reported. In these experiments, the 4%-enriched UO_2 fuel rods were moderated by 81.5% D_2O in H_2O; the non-moderator-to-moderator volume ratio was 1.0, and the material buckling was measured as a function of temperature to approximately 400°F. Critical experi-

ments were performed with 4%-enriched UO_2 fuel rods in moderators containing 0% (Core X) and approximately 70% (Core XI) D_2O. The non-moderator-to-moderator volume ratio in each core was approximately 1.2. The critical mass, dρ/dh, bucklings and reflector savings, thermal disadvantage factor, and Cd ratios of U^{235} and U^{238} were measured in each core. The objectives and conceptual design of the Small Lattice Experiments are given. Minor revisions of the BPG Code are outlined. Final calculations of the parameters measured in the first phase of the program (non-moderator-to-moderator volume ratio of 1.0) are compared with experimental data and are summarized. Supporting calculations include the reactivity-period relation for Cores X and XI, transient coefficients for 2.46%-enriched UO_2 fuel (for hazards evaluation), and initial investigations of the Small Lattice Experiments. (auth)

30007 (CEND-108) REACTOR THEORY DEVELOPMENT PROGRAM FOR ABWR. Annual Progress Report, October 1, 1959-September 30, 1960. E. A. Newburg and L. C. Noderer (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). 1960. Contract AT(10-1)-967. 42p. (IDO-19022)

Development of analytical techniques for predicting the static and dynamic behavior of boiling water reactors is reported. The validity of these techniques will be tested by application to experimental boiling reactors. During the past year, the work has fallen into three main phases aimed at better determination of the stability, static behavior, and transient behavior of boiling water reactors. Aspects of static reactor behavior were examined by first reviewing the available literature on theory and experiments concerning steam void distributions which play a large part through their reactivity effects. Here, the uncertainties in steam-water velocity ratios, sub-cooled boiling and two-phase pressure drops present the main problems. The best of the current methods were then incorporated into a boiling water reactor thermal and hydraulic code STREAC which yields the void distribution for each channel of a boiling reactor when the power distribution is known. Initial attempts were made in studying the characteristics of bubble coalescence and its role in improving the basic physical theory of fluid flow and heat transfer in a boiling channel. Since the maximum power rating of a given reactor is often limited by stability characteristics, a boiling water reactor transfer function digital code, TPF-1, which gives the power amplitude and phase response to an oscillating reactivity input was devised. In considering approximations to transfer functions, the ability of the residue method to represent a typical transform over a large range of frequencies is clearly shown. Since the stability methods used depend upon the linearization of the kinetic, hydraulic, and thermodynamic equations, the question of their validity in representing the stability of a truly non-linear system is discussed. A knowledge of the transient behavior of a reactor to accidents or power demand changes is necessary. Numerical methods are being investigated for use in coding the transient reactor equations for digital computers. Lancos' τ method, which seems to have some possibilities in greatly reducing the machine time required, and its application to simple kinetics equations is presented. Future work will immediately be more concerned with applying and improving the transfer function code and continuing investigation of methods for designing digital transient codes. Further work remains in basic bubble theory and more complete synthesis of neutronic, hydraulic, and thermodynamic codes. (auth)

30008 (EURAEC-231) IMPROVEMENT OF THE HEAT TRANSFER OF BOILING WATER REACTORS. Quarterly Report No. 7, Fourth Quarter 1961. (Société Nationale d'Etude et de Construction de Moteurs d'Aviation. Division Atomiques, Suresnes, France). Jan. 24, 1962. Work Performed under United States-Euratom Joint Research and Development Program. Contract 058-61-7RDF(86). 15p.

A general survey was conducted on the technology of the fuel elements of boiling water nuclear reactors. The tests on two phase water-air discharge in a test length provided with four rods and the image of the surrounding wall or rods were initiated by preparing the measurement methods. It appeared that with this new geometry a fairly prolonged period for the establishment of the system was necessary downstream of the air injection for the measurement of the head loss and downstream of the injection of the leading bubble for the measurement of the vacuum fraction. For the thermal tests at atmospheric pressure, a redesigning was carried out comprising in particular an increase in the d-c input from 180 to 300 kw, electric connections with the test length (12,000 amps.), the addition of a 25 kw heater and the provision of flow meters and pressure locks with a fast response. The finalizing of the measurement equipment was started on the 1-cm dia circular tubular test length which will also be available for the high pressure tests. The four rods test length is in the course of preparation. Assembly of a loop was continued in which the temperature can rise to 300°C. The first tests are scheduled. Design and construction of a detector of steaming crisis by means of which it will be possible to locate the point where such crisis takes places is reported. The interest in these data became apparent during the first phase of the research. (auth)

30009 (EURAEC-238) FABRICATION OF SWAGED UO_2 FUEL ELEMENTS. Quarterly Progress Report No. 6, October-December 1961. (Nuklear-Chemie und -Metallurgie G.m.b.H.: Wolfgang bei Hanau am Main, Germany). [nd]. Work Performed under United States-Euratom Joint Research and Development Program. 31p.

During the report period, samples of melted UO_2 powder, especially precipitated powder, and temperature post-treated powder were swage tested. V2A tubes, with wall thicknesses of 0.4 and 0.3 mm were used for cladding. Swaging tests with thin-walled tubes yielded excellent tube surfaces when a four-jaw machine was used. Swaged densities of UO_2 were found to increase with increasing temperatures at 600, 750, and 900°C. Other tests were conducted to determine the change in tube-wall thickness in relation to the swaging cross-section reduction. Density, porosity, and stoichiometry measurements were made on swaged tubes. Trial fabrication of specific fuel elements is reported. (J.R.D.)

30010 (GA-1972) REFUELING GAS-COOLED REACTORS. S. L. Koutz (General Atomic Div. General Dynamics Corp., San Diego, Calif.) and J. Foster (Oak Ridge National Lab., Tenn.). Mar. 6, 1961. Contracts AT (04-3)-314 and AT(10-D)-925. 13p.

Refueling of gas-cooled reactors is discussed. The refueling systems for the Experimental Gas Cooled Reactor and the High Temperature Gas Cooled Reactor are described. (M.C.G.)

30011 (GEMP-73) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 73. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). July 31, 1962. Contract AT(40-1)-2847. 87p.

Activities in programs for development of reactor instrumentation and control are reported. A summary of efforts in a program to complete initial development of Monte Carlo computer programs and necessary auxiliary programs for nuclear analysis of complex reactor and shield systems is included. Progress is reported in programs to develop a control which is capable of operating around sharp bends, and solid state switching devices. Other developmental work is reported on probe-type temperature sensors, high-temperature nuclear sensors, Inconel X high-temperature fasteners, and remotely operated fasteners. (J.R.D.)

30012 (HW-72048) FISSION PRODUCT POISONING IN A MODEL PLUTONIUM RECYCLE SYSTEM WITH CLOSE-COUPLED FUEL REPROCESSING. G. Jansen, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 2, 1962. Contract AT(45-1)-1350. 47p.

A general method developed for determining the effects of fission product decontamination factors on neutron poisoning in Pu recycle reactors at steady state is described. The effects of non-removal of each fission product nuclide during intercycle processing was determined for a model recycle system as a function of the decontamination factor (DF). Estimates of the value of the neutrons lost to removable poisons indicate that DF's of 3 and 10 for all fission products in the model recycle system result in a loss of neutrons valued at $8.00 and $2.00, respectively, per kg per fuel cycle. Comparison of these losses with processing costs projected for Pu recycle reactors shows that a DF of 3 is probably low, whereas a DF of 10 is more attractive. (J.R.D.)

30013 (HW-73600(Rev.)) ATR GAS LOOP FOR STRUCTURAL MATERIALS IRRADIATION. D. C. Kaulitz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 5, 1962. Contract AT(54-1)-1350. 16p.

A gas-cooled loop for the ATR to investigate combined effects of temperature, environment, and neutron irradiation on structural materials for future reactors is described. The loop will operate with a 1500°F inlet temperature. The proposed gas loop consists primarily of an in-reactor test section and a recirculating gas coolant system. The gas circulated is He with provisions for slight oxygen additions. Design criteria are given for the mechanical equipment. (M.C.G.)

30014 (IDO-16773) CALCULATION AND MEASUREMENT OF THE TRANSIENT TEMPERATURE IN A LOW-ENRICHMENT UO_2 FUEL ROD DURING LARGE POWER EXCURSIONS. J. E. Houghtaling, T. M. Quigley, and A. H. Spano (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 18, 1962. Contract AT(10-1)-205. 22p.

The results of Spert I in-pile transient tests of a rod-type, low-enrichment UO_2 fuel element are presented. The tests were performed to investigate the possibility of damage to such long thermal-time-constant fuel rods when subjected to short-period power excursions, and to test the effectiveness of an instrumentation technique for measurement of UO_2 fuel temperatures within the rods. In an initial series of power excursion tests, in which the range of reactor periods was from approximately 1 sec to 7.5 msec, simultaneous measurements were made of the transient temperature at the center of the fuel rod and at the outer cladding surface. Fuel rod rupture occurred during the exponential rise of the 7.5-msec excursion. Similar short-period tests performed on a second fuel rod containing no internal thermocouples did not result in cladding failure, supporting the postulation that rupture of the first rod was caused by waterlogging of the UO_2 as a result of the cladding penetrations made for installation of the internal thermocouples. Calculations of the transient temperature distribution in the fuel rod were made, and the results are found to be in good agreement with the experimental data obtained on the central-UO_2 and cladding-surface transient temperatures. (auth)

30015 (IDO-16774) CALCULATION OF DEPARTURE FROM NUCLEATE BOILING CONDITIONS FOR THE SPERT III REACTOR IN THE HIGH PRESSURE REGION. J. Dugone (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 18, 1962. Contract AT(10-1)-205. 58p.

Calculations are made to determine the safe steady-state power operating limits of the Spert III reactor from the viewpoint of fuel plate burnout. A computer program is developed for the IBM 704 to aid in these calculations. The Bettis design departure from nucleate boiling (DNB) equation is used in conjunction with the LeTourneau and Grimble method of "hot channel" analysis in the development of the calculations. For cases where DNB occurs in the bulk boiling region, a modified Martinelli-Nelson two-phase flow correlation and some experimental single-phase pressure drop data are employed. DNB for a typical operating condition of 550°F inlet temperature and 2500 psig is computed to check the code. The results of the sample calculation show that at a steady-state power level of 60 Mw (maximum design power) the minimum flow rate required to prevent DNB is approximately 8000 gpm. (auth)

30016 (JAERI-1032) MEASUREMENTS AND CALCULATIONS FOR GRAPHITE-MODERATED ENRICHED-FUEL CRITICAL ASSEMBLY, SHE. K. Inoue, M. Iizumi, S. Kobayashi, and K. Sumita (Japan Atomic Energy Research Inst., Tokyo). 1962. 25p.

To understand the reactor physics in enriched-fuel, graphite-moderated thermal reactors theoretical and experimental investigations were performed. A critical assembly was used to obtain the criticality data. An approach of criticality calculations was developed, and it is demonstrated that the procedure is feasible in the limited area such as in the case of enriched-fuel, graphite-moderated small thermal reactors. The agreement between the theoretical and experimental criticality data is good. The effect of chemical binding in the graphite is of interest in the thermal reactor. Results of theoretical calculations are also presented. (auth)

30017 (KR-21) CRITICAL CALCULATIONS OF THE SPECTRAL SHIFT REACTOR WITH THE SAVANNAH FUEL CHARGE. K. Kowalska, K. I. Matsuoka, and N. L. Snidow (Norway. Institutt for Atomenergi, Kjeller). May 1962. 47p.

Parametric calculations of the infinite multiplication factor and material buckling were made for a light and heavy water moderated zero power assembly with the Savannah type of fuel. The moderator-to-fuel volume ratio and the composition of the D_2O-H_2O mixture were variable parameters. The purpose of this part of the NORA program was to form a basis for opinion on the possibilities of achieving criticality in each alternative with a given number of fuel rods and in a tank of given dimensions. Neutron temperature, thermal utilization, resonance escape probability, fast effect, infinite multiplication factor, diffusion area, slowing down area, material buckling, critical core size, and critical mass are discussed. (M.C.G.)

30018 (LA-2735) FAST REACTOR CORE TEST FACILITY SAFETY ANALYSIS REPORT. (Los Alamos Scientific Lab., N. Mex.). Aug. 1962. Contract W-7405-Eng-36. 155p.

The Fast Reactor Core Test Facility is designed for testing and evaluating a sequence of plutonium-fueled, sodium-cooled reactor core concepts. Capacity of sodium coolant systems is sized for dissipating up to 15 Mw of core heat and 5 Mw of breeding blanket heat. A general description of the Facility building, reactor coolant systems, and auxiliary test equipment is given. The probable effects of Facility-connected operational errors and component failures are studied. Radioactivity released as a consequence of credible accidents can be contained within the building without hazard to operating personnel or personnel in surrounding areas. (auth)

30019 (NASA-TN-D-1322) CRITICALITY EFFECTS OF CENTRALLY LOCATED TUBES AND RODS OF ALUMINUM, IRON, AND TUNGSTEN IN A HOMOGENEOUS REACTOR. Daniel Fieno, Eugene Gunn, Clayton Barber, Thomas Fox, Donald Alger, and Robert Mueller (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1962. 27p.

The NASA zero-power reactor, consisting of an unreflected cylinder containing a solution of uranyl fluoride salt in water, was used to study simple heterogeneous effects. This heterogeneity was introduced into the reactor as tubes or rods of aluminum, iron, and tungsten. For a given hydrogen- to uranium-235-atom ratio of the fuel solution, criticality was achieved by varying the height of the fuel solution contained in a 12-inch-inside-diameter tank. Criticality measurements of cylindrical void regions located on the axis of the reactor were also made. These measurements were analyzed by using 19 energy groups with a one-dimensional diffusion-theory code written for the IBM 704 computer. (auth)

30020 (NP-11922) RECENTI METODI DI INDAGINE SUL CHIMISMO DEI MODERATORI ORGANICI. (Recent Methods of Research on the Chemistry of Organic Moderators). G. Cicognani (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Calcolo, Rome). June 1962. 42p. (RT/CHI(62)4)

The development of studies on organic compounds used in an organic cooled and moderated reactor is discussed. The most recent methods of analysis, such as gas-chromatography, mass spectrometry, infrared spectrometry, and capsule-experiments are described. A loop-experiment is also described. (auth)

30021 (ORNL-TM-291) HOMOGENIZATION OF MOLTEN-SALT REACTOR PROJECT FUEL SAMPLES. M. J. Gaitanis, C. E. Lamb, and L. T. Corbin (Oak Ridge National Lab., Tenn.). July 5, 1962. Contract [W-7405-eng-26]. 7p.

A copper pulverizer-mixer was designed for homogenizing Molten-Salt Reactor Project (MSRP) fuel. The copper sampling ladle that contains the solidified fuel is placed in the pulverizer-mixer, which is agitated on a mixer mill. The fuel is fractured out of the ladle, pulverized into a homogeneous powder, and transferred to a storage bottle. The homogenized fuel sample is then available for analysis. (auth)

30022 (ORO-578) MATERIALS FOR HIGH TEMPERATURE NUCLEAR ENGINEERING APPLICATIONS. Quarterly Report No. 1, August 15, 1961–April 1, 1962. J. D. Fleming, J. W. Johnson, Paul Boland, S. H. Bomar, and A. R. Colcord (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Contract AT(40-1)-2483. 82p.

In silica investigations, devitrification curves were run with fused samples. The devitrification rate was found to be lower with graphite mold releases, also, better handling characteristics were found with these releases. The effects of the firing atmosphere on the properties of slip cast fused silica were investigated. The rupture modulus was greater than 5400 psi at 2000°F for steam-fired samples compared with 4200 psi for those fired in air. Alumina bars cast with vibration and pressure fired at 2250°F showed an air displacement porosity of 28.1% and a modulus of rupture of 17,000 psi. In Al-U_3O_8 reaction tests it was found that with increasing Al content the ignition became less violent with an accompanying decrease in temperature. Analytical results indicated 95% reaction of the Al in 14.6 wt % Al thermets. Residual U_3O_8 was indicated in reactions involving U_3O_8 of a particle size greater than 140 mesh. Electron microprobe analyses of fired Al-U_3O_8 thermets showed the presence of UO_2, UAl_2, and Al_2O_3. Reactions of 7.9 wt % 325-mesh Be with U_3O_8 appeared more vigorous than the corresponding Al-U_3O_8 reactions. (J.R.D.)

30023 (PAN-305/IX) ASYMPTOTIC REACTOR THEORY IN PLANE GEOMETRY. Janusz R. Mika (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 10p.

The critical conditions for slab reactor systems satisfying the assumptions of the asymptotic reactor theory are derived. The formulas are based upon the solutions of the two basic problems in neutron transport theory: half-space and two adjacent half-spaces. (auth)

30024 (TID-16434) LECTURE ON STRUCTURAL EVALUATION OF REACTOR PRESSURE VESSELS TO BE PRESENTED JULY 24, 1962 AT UNIVERSITY OF CALIFORNIA, LOS ANGELES, CALIFORNIA. Frank J. Mehringer (Knolls Atomic Power Lab., Schenectady, N. Y.). Contract [W-31-109-eng-52]. 39p.

Types of nuclear power plant pressure vessels are discussed. The types of failure to be considered in structural evaluations of pressure vessels are described. These include rupture, brittle fracture, excessive elastic deformation, buckling, excessive plastic deformation, fatigue, corrosion fatigue, stress corrosion, and metal wastage. Stress concentration effects are discussed. (M.C.G.)

30025 (UCID-4170) ZOOM CALCULATIONS OF HOT BOX. HOT BOX NOTE NUMBER 28. R. Freis (California. Univ., Livermore. Lawrence Radiation Lab.). June 23, 1960. Contract [W-7405-Eng-48]. 9p.

Criticality calculations were made on the 709 Zoom Code based on two bare graphite reactors. These reactors consisted of graphite blocks, 12 × 12 inches in cross section and either 1 or 2 inches thick. Fuel foils (93.2% uranium-235 hermetically sealed in two-mil thick type 347 stainless steel) were loaded in horizontal planes to give a constant spacing of 5 inches between planes, and the core dimensions were 72 × 72 inches by critical height. Criticality was determined by keeping the C/U^{235} molar ratio constant at 8700 and varying the buckling. In the calculations each reactor was considered with two different approximations of the loading. In one case, the reactor was treated as a homogeneous one region problem with a C/U^{235} molar ratio of 8700. In the second case each half of the reactor was divided into three homogeneous regions in which the first and third regions had $\frac{1}{8}$ the total fuel and the second region had $\frac{1}{4}$ the total fuel. (N.W.R.)

30026 (UNC-5015) FUEL CYCLE DEVELOPMENT PROGRAM. Quarterly Progress Report, January 1 to March 31, 1962. (United Nuclear Corp. Development

Div., White Plains, N. Y.). June 8, 1962. Contract AT(30-1)-2374. 41p.

The permanent shutdown of the Westinghouse Testing Reactor at the end of the quarter forced a revision in plans for programming the remainder of the irradiation of the two uninstrumented capsules whose testing was in progress. The minimum estimated burnup at this point, based on hot cell data obtained from the pilot capsule, was 13,100 MW-d/ton U. It was decided to continue the testing of only one capsule in another reactor until the original goal of 20,000 MW-d/ton U is reached. The irradiation of the second capsule is to be terminated so that it can serve as a control. Fabrication was initiated on enriched UO_2 pellets for incorporation in full scale fuel rods to be irradiated in the Vallecitos Boiling Water Reactor. A wet nitrogen pyrohydrolysis step in conjunction with oxidation-reduction cycling is being used to attain a satisfactory density exceeding 95% of theoretical at 1150°C. Apparatus and procedures being used for measurement of thermal conductivity and thermal expansion of sintered and cast uranium carbide are described. The coefficient of linear thermal expansion for a single specimen of 4.37 wt. % carbon sintered uranium carbide was determined to be 11.8×10^{-6} mm/mm-°C, while that for a cast uranium carbide specimen containing 4.73 wt. % carbon was 10.6×10^{-6} mm/mm-°C over the range from room temperature to 1000°C. Hardness data for 4.4 and 4.8 ± 0.1 wt. % carbon sintered and cast uranium carbide and for 5.2 wt. % carbon cast material are also presented. Irradiation test specimens previously prepared were given a pre-irradiation examination and were encapsulated. Three capsules, two using a sodium bond between fuel and container and one using an interference fit between fuel and container, were loaded in the MTR and appear to be operating under the required conditions. (auth)

30027 (UNC-5030) CARBIDE FUEL DEVELOPMENT. Progress Report, April 1, 1962 to June 30, 1962. A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.) and K. Taylor (Carborundum Co., Niagara Falls, N. Y.). Aug. 10, 1962. Contract AT (30-1)-2899. 18p.

All of the UC-PuC powder required for the natural U irradiation specimens, and some of the powder required for the enriched U irradiation specimens was synthesized. All of the natural uranium UC-PuC pellets required were fabricated by pressing and sintering, and are being ground to size. The average density of the $(U_{0.8}Pu_{0.2})C_{0.95}$ pellets was 12.54 g/cm³ (92.4% of theoretical) and of the $(U_{0.8}Pu_{0.2})C_{0.95}$ plus 0.1 wt % Ni pellets was 13.15 g/cm³ (96.8% of theoretical). Cored pellets were fabricated by pressing and sintering, and the holes are being reamed to size to provide a place for an accurately located central thermocouple. The initial clad irradiation specimens were assembled, and the assembly of the first irradiation capsule was started. The test reactor choice was narrowed to ETR and GETR. The GETR is recommended for at least four of the six capsules. (auth)

30028 (WAPD-T-1450) A COMPARISON OF A SELF-ADJOINT VARIATIONAL METHOD TO 36-GROUP THERMAL SPECTRUM CALCULATIONS OF HETEROGENEOUS SYSTEMS. S. L. Shufler (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-GEN-14. 35p.

A self-adjoint variational principle related to the thermal neutron spatial spectrum problem by Buslik was tested against a 36-group thermal code and a few-group code for typical one-dimensional heterogeneous arrays. A description of the theoretical method is given including some observations of the differences between the self-adjoint method of Buslik and the nonself-adjoint formalism reported by Calame and Federighi. A comparison of nuclear parameters, activation shapes, and local region capture fractions are presented for three types of one-dimensional arrays: absorber-fuel cells, absorber-nonfuel-fuel cells, and absorber-fuel-nonfuel cells. Some comparisons of the mixed number density method to the variational model are also included. Results indicated the utility and proof of the success of the self-adjoint variational principle in predicting the important nuclear parameters of a wide range of fuel-nonfuel-absorber combinations at both cold and hot temperatures. (M.C.G.)

30029 (WAPD-T-1463) SYNTHESIS APPROXIMATIONS IN THE TIME DIRECTIONS. J. A. Bewick, A. F. Henry, and S. Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 19p.

Application of an approximation procedure in which the solution is approximated by a linear combination of functions which are known, to reactor problems involving the time variable is described. The approximate solution has the form $\phi(x,y,z,t) = T_1(t)\,\Psi_1(x,y,z)t \ldots . Tn(t)\Psi_n(x,y,z)$ where $\Psi(x,y,z)$ are spatial shapes appropriate to various ranges of t. Illustrations are given corresponding to three different time scales. (J.R.D.)

30030 (DEG-Inf-Ser-259) REACTOR PRESSURE VESSELS. R. Mattera. Translated by G. R. A. Metcalfe (U.K.A.E.A. Development and Engineering Group, Risley, Lancs, England) from Bull. tech. Bur. Veritas, 42: 37-59 (1960). 44p.

Problems associated with pressure vessels for reactors are examined. Information is included on codes, activity summary concerning the pressure vessel research committee, static and dynamic internal pressures, thermal gradients, force and stress concentrations, cyclic loading and plastic fatigue, and exceptional loads caused by reactor excursions. Bibliographies are included. (J.R.D.)

30031 THE EFFECT OF PLUTONIUM-239 ON THE THERMAL NEUTRON SPECTRUM IN GRAPHITE-MODERATED SYSTEMS. A. Schatz. Atomwirtschaft, 7: 361-4(July 1962). (In German)

Calculations of the thermal neutron spectrum were made to determine the effect of Pu^{239} bred after a certain time on the critical state and the temperature coefficient of the reactor and to ascertain if it is possible to add Pu^{239} to the reactor as fuel without endangering the stability of the reactor which results from the negative temperature coefficient of reactivity. The results of the calculation are not limited to pebble bed reactors but apply generally to graphite-moderated systems. The questions were first investigated for a homogeneous, infinite scattering medium, and the positional dependence of the neutron spectrum was taken into consideration. The spectrum was calculated by iterative solution of the simplified Boltzmann equation for an infinite homogeneous scattering medium. The gas model was used for the determination of the scattering kernel. It was shown that the thermal neutron spectrum with good moderation and a small charge of Pu^{239} can be represented well by a hardened Maxwell distribution. On the other hand, if the Pu^{239} or the total charge of fissioned material is large, then the approximation is poor. The definition of a hardened neutron temperature is no longer significant for a very large Pu^{239} concentration. (J.S.R.)

30032 THE HARMONICS METHOD FOR NUCLEAR REACTOR ANALYSIS. Charles Allen Stevens (Univ. of

Michigan, Ann Arbor). Dissertation Abstr., 23: 193(July 1962).

The harmonics method for the analysis of nuclear reactors was developed to a much greater extent than has been published previously. The multigroup diffusion equations commonly used for reactor criticality calculations are solved by expanding the fluxes in terms of eigenfunctions of the Helmholtz equation. In this manner, the original coupled differential equations are reduced to algebraic equations. The number of these equations is quite large for most practical applications. Thus an iterative procedure, based on a variational principle, is developed to handle the equations in a very efficient manner. In this way, the neutron fluxes, flux adjoints, and effective multiplication factor of a reactor are obtained. A similar procedure is developed for the non-critical reactor. By taking Laplace transforms of the time-dependent multigroup equations, a generalized inhour equation is obtained. The harmonics method is shown to compare quite favorably with the more commonly used finite difference methods.

30033 PROBLEMS CONNECTED WITH THE USE OF PULSED REACTORS TO ATTAIN VERY HIGH NEUTRON FLUXES. Bruce William Hapke (Cornell Univ., Ithaca, N. Y.). Dissertation Abstr., 23: 274(July 1962).

Several neutron producing devices are examined with the object of discovering their inherent limitations. The ultimate neutron flux level, integrated flux, and minimum pulse duration which can be obtained using the devices are estimated. Pulsed reactors are examined in considerable detail and a number of means for increasing the peak neutron flux which can be attained in a prompt reactor transient are suggested. A preliminary design incorporating the suggestions is brought forward for a pulsed reactor which could generate peak thermal neutron flux levels of greater than 1×10^{19} neutrons/cm^2/sec for several milliseconds. The theoretical space-dependent analysis of prompt transients in reactors is also discussed. Conditions are derived which must be met if it is to be useful to describe the neutron density by the product of a slowly varying shape function (which gives the instantaneous neutron distribution in phase space) and a rapidly varying amplitude function. These conditions are usually met in pulsed reactors. A modified form of time-independent perturbation theory is introduced and used to calculate the instantaneous neutron density in a simple model of a pulsed reactor.

30034 FUEL LOADING OF HIGHLY ENRICHED REACTORS. Peter J. Kannam (Pennsylvania State Univ., University Park). Dissertation Abstr., 23: 274-5(July 1962).

Proper techniques to facilitate the multi-region fuel loading of highly enriched reactors were developed, and investigations on the use of cadmium as a burnable poison and the effect of fuel cycling on the flux distribution and power production were studied. The theoretical investigation consisted in deriving expression for reactivity from the perturbation theory. The two group diffusion theory was assumed, taking into consideration absorption and fission both in the fast and the thermal groups. A detailed application of matrix theory and adjoint fluxes in deriving the expression was also shown. Expressions for reactivity change due to fuel depletion, fission product buildup and poison were derived separately. An investigation into various nuclear reactions taking place during fission in the reactor was also made. The experimental investigation consisted in solving steady state equations using the IBM 7090 computer and also in determining the thermal flux by direct irradiation of cobalt–aluminum wire. The reactor model used was Westinghouse Testing Reactor (WTR). In order to comply with the restriction of the perturbation theory that the magnitude of perturbation on the parameters should be small, the reactivity change was calculated for each time-step. The space-dependence and the time-dependence of the parameters were evaluated by dividing the core into regions and dividing the reactor cycle into time-steps, respectively. The total reactivity requirement for 1440 MWD of operation was calculated to be 9.8%, out of which 4.8% was used for fuel depletion and the rest for the fission products. The effect of poisoning the core uniformity with 135 gm of Cd was found to be a change in total reactivity excursion by 5.4%. The reactivity worth of a new fuel element at various regions of the core was calculated. The calculations were further extended to fuel elements with different burnups. A family of curves was constructed for reactivity as a function of burnup for various regions and the applications of these curves in calculating fuel loading requirements of any specified cycle were clearly illustrated. A four-region cycling scheme was demonstrated. The burnup of the fuel elements removed at the end of each cycle was found to be approximately 3%. The thermal flux in each region was observed to increase until the core reached equilibrium. The effect of fuel cycling on the power density was to decrease the power density by 18% at the center of the core, and to increase it by 10% at the periphery.

30035 STATISTICS OF ZERO POWER NUCLEAR REACTORS. R. W. Albrecht (Univ. of Washington, Seattle). IRE Trans. on Nuclear Sci. NS-9, No. 4, 1-4(Aug. 1962).

In a zero power nuclear reactor operating in steady state, fluctuations in the neutron population around the average population are observable. These fluctuations are related to the dynamic parameters of the reactor and may be of interest in measurements of dynamic parameters or in the analysis of sensitive experiments in which the characteristics of this population fluctuation are important. Equations are developed for the autocorrelation function and the power spectral density function for zero power, point reactor fluctuations. An equation is also derived for the ratio of the variance to the mean of the integrated value of the noise as a function of time interval. The derivation of these equations uses concepts of noise analysis. The effects of delayed neutrons and of source neutrons are included. A typical experimental curve for the variance-to-mean ratio taken on the Ford Nuclear Reactor is shown, which displays the form of this function. (auth)

30036 A REACTOR SIMULATOR FOR TEACHING AND TRAINING PURPOSES. E. Gass, R. Lauber, H. Lauffer, and G. Schweizer (Technische Hochschule, Stuttgart). Kerntechnik, 4: 277-81(July 1962). (In German)

The design and the basic requirements for reactor simulator for teaching and training purposes are discussed. It is shown that a simulator with fixed wired programs, which can be selected from a control console by push buttons, will fit the necessary requirements. By using suitable mathematical models, which are simulated in program units, the reactor simulator is feasible with reasonable costs. Applying this concept, the reactor simulator can be used to demonstrate and to compare the dynamics and the operation of various types of nuclear power plants with sufficient accuracy. The design of the circuits for the fixed programs is shown and some units are considered in detail. Some experiments which can be performed with the reactor simulator are described. (auth)

30037 TEST RIG INSTRUMENTATION—2. A. D. Wright and G. G. Ballard (Elliott Nucleonics, London). Nuclear Power (England), 7: 59-63(Aug. 1962).

Instrumentation features for out-of-pile test rigs for testing control rods and mechanisms for gas-cooled and pressurized-water reactors are detailed. The main rig is capable of housing the entire mechanism under simulated reactor conditions, and has an over-all height of over 80 ft. Supplementary rigs are also described, for use in component testing under simulated reactor conditions. (T.F.H.)

30038 REACTIVITY AND KINETIC RELATIONS FOR REACTORS. Russell M. Ball (Babcock and Wilcox Co., Lynchburg, Va.). Nucleonics, 20: No. 8, 122-3(Aug. 1962).

Graphs are given for various reactor kinetic relationships and unit conversions and are based on measured neutron-delay fractions by Keepin and error calculations by Toppel. The graphs are effective multiplication constant vs reactivity, reactivity in cents vs absolute reactivity, reactivity in cents vs doubling time, doubling time vs decades/min, doubling time vs reactor period, fractional error vs asymptotic period, and time vs positive asymptotic period. (D.L.C.)

30039 TRANSIENT HEAT TRANSFER FROM CERAMIC FUEL PINS. David H. Crimmins (Allis-Chalmers Mfg. Co., Milwaukee). Nucleonics, 20: No. 8, 131-2(Aug. 1962).

A method is given for finding the transfer function of a ceramic fuel pin which describes the time lag between heat generation and heat flow into the coolant. The transfer function G(s) is obtained by calculating the Biot number and time constant from the fuel pin parameters and using a graph and an equation. A sample calculation is given. (D.L.C.)

30040 THE DETERMINATION OF THE EFFECTIVENESS OF NUCLEAR REACTOR CONTROL RODS BY MEANS OF EXPONENTIAL EXPERIMENTS. C. G. James and C. E. Till (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), A, 269: 66-79(Aug. 21, 1962).

The conditions under which an exponential assembly may be used to determine control rod effectiveness are considered. It is concluded that a necessary condition for measurements to be analyzed by simple theory is that the neutron energy-spectrum perturbation produced by the rod should not extend over the whole volume of the assembly; the unperturbed asymptotic spectrum should be regained within the pile. Neutron balance equations in two energy groups for a square subcritical assembly with a cylindrical absorber along the axis are outlined. Measurements made in a graphite-natural uranium exponential pile are presented for boron steel, cadmium, and mild steel control elements, all in the form of circular tubes ranging from 0.625 to 3.375 in. outer diameter. The results are discussed in terms of thermal neutron extrapolation lengths. They indicate that absorption of thermal neutrons accounts for some 80% of the total effects in the case of boron steel, a larger proportion for cadmium, and almost the whole effect for mild steel. The effect of placing moderating materials in the center of the rods is investigated. For boron steel and cadmium increases in effectiveness up to 20% are observed with moderating inserts of a hydrogenous material, while graphite is found to produce no significant change. Hydrogenous inserts increase the effectiveness up to 40% with mild steel rods, but the effect appears to be attributable mainly to absorption of thermal neutrons by the inserts, rather than to moderation of fast neutrons. The results show internal consistency, supporting the validity of the technique. The sensitivity of the method appears comparable with that of measurements on a critical system with a similar lattice. (auth)

30041 APPLICATION OF CRITICAL PATH SCHEDULING METHOD TO THE PRESTARTUP ACTIVITIES IN A NUCLEAR REACTOR. C. T. Hayner (General Electric Co., Richland, Wash.). Preprint Paper No. 46. New York, Engineers Joint Council, 1962. 15p. (HW-72778)

A brief, basic background on the critical path scheduling method is given to outline the extreme versatility of this discipline as a planning, scheduling, and control tool for management. The application of the method to control of nuclear products processing in the New Production Reactor at Hanford is presented. (L.T.W.)

30042 ANALYSIS OF REACTOR SUPPORT GRIDS. Charles E. Aldrich, Jr., Joseph E. Cadoret, Jr., and Leslie H. Chen (General Dynamics, Groton, Conn.). Preprint Paper No. 56. New York, Engineers Joint Council, 1962. 28p.

A stiffness matrix method for structural analysis by which reactor support grids may be analyzed for deflections and internal forces due to thermal and mechanical loadings is presented. The method allows for shear lag in the grid plate and includes the effects of normal force, shear, bending, and torsion. A formalized procedure is established by which three dimensional support structures subjected to various conditions of constraint may be analyzed in a routine manner. Emphasis has been on the simplicity of the generalized procedures which are well-suited for automatic computation on digital computers. (auth)

30043 COMPUTER TECHNIQUES FOR STRESS ANALYSIS OF REACTOR VESSELS. Leo M. Cassidy and Robert J. McGrattan (General Dynamics, Groton, Conn.). Preprint Paper No. 57. New York, Engineers Joint Council, 1962. 30p.

The facility with which certain stress analysis problems associated with reactor pressure vessels can be solved through the use of high speed computers is demonstrated. The analyses presented have been programed for the IBM 704 digital computer. (auth)

30044 NUMERICAL SOLUTIONS OF STRESS PROBLEMS IN REACTOR FUEL ELEMENTS. R. F. Redmond and L. E. Hulbert (Battelle Memorial Inst., Columbus, Ohio). Preprint Paper No. 58. New York, Engineers Joint Council, 1962. 16p.

A numerical technique is described for solving complex stress problems in reactor fuel elements. The numerical approach used is an iterative one analogous to the relaxation technique for determining the stress function at a finite number of points in the body. Convergence behavior is discussed and a typical problem is described. (L.T.W.)

30045 COMMERCIAL IMPLICATIONS OF RADIATION EFFECTS ON REACTOR PRESSURE VESSEL DESIGN, FABRICATION AND OPERATION. L. R. Weissert and D. K. Davies (Babcock and Wilcox Co., Lynchburg, Va.). Preprint Paper No. 65. New York, Engineers Joint Council, 1962. 19p.

The implications of radiation effects on basic design and operating factors incident to reactor pressure vessels in pressurized water and boiling water service are outlined. A summary is given of existing commercial power and propulsion reactors together with the vessel operating conditions. The areas of design, fabrication, and operation are discussed as to how they are affected by neutron and gamma radiation. (L.T.W.)

30046 FACTORS ESTABLISHING LIMITS FOR RELEASE OF EFFLUENTS FROM THE PLUTONIUM RECYCLE TEST REACTOR. R. F. Foster, G. E. Backman, N. G. Wittenbrock, and J. M. Skarpelos (General Electric

Co., Richland, Wash.). Preprint Paper No. 74. New York, Engineers Joint Council, 1962. 30p. (HW-SA-2475)

The principal factors which must be considered in establishing permissible release rates and how these factors influenced the selection of operational guides for the aqueous and gaseous effluents from the Plutonium Recycle Test Reactor are discussed. (L.T.W.)

30047 CONTROL ROD ROTATING MECHANISM. A. Baumgarten and A. J. Karalis (to U. S. Atomic Energy Commission). U. S. Patent 3,010,887. Nov. 28, 1961.

A threaded rotatable shaft is provided which rotates in response to linear movement of a nut, the shaft being surrounded by a pair of bellows members connected to either side of the nut to effectively seal the reactor from leakage and also to store up energy to shut down the reactor in the event of a power failure. (AEC)

30048 REACTOR CONTROL ROD OPERATING SYSTEM. G. Miller (to U. S. Atomic Energy Commission). U. S. Patent 3,012,542. Dec. 12, 1961.

A nuclear reactor control rod mechanism is designed which mechanically moves the control rods into and out of the core under normal conditions but rapidly forces the control rods into the core by catapultic action in the event of an emergency. (AEC)

Power Reactors

30049 (ACNP-62006) PATHFINDER ATOMIC POWER PLANT STEAM SEPARATOR DEVELOPMENT. G. C. Kutsch, D. H. Swanson, and H. W. Yant (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 15, 1962. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT (11-1)-589. 170p.

Development of a steam separator the Pathfinder Reactor is reported. A full-scale separator model was developed through the combination of scale-model testing and the application of principles associated with the existing theory of centrifugal separation. This model was put through full-scale air-water tests which led to modifications and a final design which meets Pathfinder requirements. Design data are included for the reactor and the steam separator. (J.R.D.)

30050 (APAE-119) POWER DISTRIBUTIONS FOR TYPE 3 REPLACEMENT CORES FOR SM-1, SM-1A AND PM-2A. J. P. Oggerino (Alco Products, Inc., Schenectady, N. Y.). July 25, 1962. Contract AT(30-1)-2639. 139p.

The most adverse power distribution and power peaking factors were developed for Type 3 replacement cores for SM-1, SM-1A, and PM-2A. Also included is the 37 element Type 3 core for SM-1, which is known as SM-1 Core III and is a prototype of a Type 3 core for the PM-2A. The power distributions were compared with measured distributions obtained on Type 3 fuel elements in SM-1, SM-1A, and PM-2A core configurations. Using the measured data as a standard, correction factors were obtained and applied to the analytical predictions of the most adverse power distribution. (auth)

30051 (APAE-Memo-317) THERMAL STRESS TESTING OF TYPE 1 FUEL PLATES. F. G. Gebhardt (Alco Products, Inc., Schenectady, N. Y.). June 27, 1962. Contract AT(30-1)-2639. 92p.

Thermal stress tests on Type 1, SM-1A Core II fuel element sections were performed to study plate distortion and determine its dependency on temperature distribution, temperature differential, initial flatness, and ripple length. Test results will be correlated with the analytical model and used to predict ripple growth in other plate-type fuel elements. The tests showed that ripple growth is dependent on initial flatness of the plate and that the characteristic shape of ripples is maintained at all temperature differentials: The tests also showed that the ripple growth rate for a ripple of 5 mil initial magnitude is approximately 0.12 mils/°F for a peak temperature differential of 103°F and that the apparent relationship between ripple net growth and length is 1.3 mil/in. of ripple for a peak temperature differential of 103°F. A permanent distortion of 2 mils for a complete temperature cycle from 0 to 103 to 0°F differential was found. The temperature profile across the plate width was found to affect the magnitude of ripple growth. (auth)

30052 (APAE-Memo-319) DETAILED STRESS ANALYSIS OF SM-1 STEAM GENERATOR TUBE SHEET. J. J. Busuttil and R. A. Chittum (Alco Products, Inc., Schenectady, N. Y.). July 11, 1962. Contract AT(30-1)-2639. 40p.

The detailed stress analysis of the SM-1 steam generator tube sheet showed it to be safe from strain cycling damage. However, the pressure stresses were greater than the yield strength during the hydrostatic test. The differential between pressure stresses and yield strength indicates that some initial deformation may have taken place in the tube sheet. (auth)

30053 (APAE-Memo-321) DETAILED STRESS ANALYSIS OF PM-2A STEAM GENERATOR TUBE SHEET. J. J. Busuttil (Alco Products, Inc., Schenectady, N. Y.). July 20, 1962. Contract AT(30-1)-2639. 34p.

A detailed analysis of the PM-2A steam generator tube sheet revealed that is is safe from strain cycling damage. The pressure stresses, however, indicated that permanent deformation would take place in the tube sheet at hydrostatic test pressure of 1.5 times design pressure. (auth)

30054 (BMI-1582) STUDIES OF FLOW AND MIXING IN A 0.4-SCALE MODEL OF THE PWR CORE 2 REACTOR. Lawrence J. Flanigan, Gale R. Whitacre, and Herbert R. Hazard (Battelle Memorial Inst., Columbus, Ohio). June 26, 1962. Contract W-7405-Eng-92. 52p.

A 0.4-scale flow model, using air as the working fluid, was used to obtain design data for the PWR Core 2 program. Three model configurations were studied. Experimental studies of core-flow distribution, mixing of flow from the inlets, mixing of flow in the space between the first and second passes of the blanket, and pressure drops throughout the model were carried out in the original configuration for three-loop and four-loop operation. The flow baffle, located in the lower plenum, and the core-support barrel, located in the upper plenum, were modified. The effects of these geometric changes on core-flow distribution, mixing of flow from the inlets, and pressure drops in the lower-plenum and upper-plenum areas were studied for a three-loop and four-loop operation. Flow resistance and flow distribution among regions in the simulated core were changed and experimental studies of core-flow distribution, mixing of flow from the inlets, mixing of flow between the first pass and the second pass of the blanket, and pressure drops throughout the model were repeated with four, three, two opposed, and two adjacent loops operating. Results obtained in the model were then converted to values applicable to water flow in the prototype. (auth)

30055 (CEND-135(Vol.IV, Suppl.)) PL FINAL DESIGN REPORT. SUPPLEMENT TO VOLUME IV. REACTOR DESIGN. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). June 15, 1962. Contracts AT(10-

1)-967 and AT(11-1)-1062. 63p. (IDO-19030(Vol.IV, Suppl.))

Revisions to Vol. IV of the PL final design report are presented. The changes presented are exclusively in the mechanical and structural design of the core. Most design changes were dictated by fabrication experience or experimental test results. A complete list of the revised drawings is included. (J.R.D.)

30056 (CEND-135(Vol.VI)) PL FINAL DESIGN REPORT. VOLUME VI. PLANT PERFORMANCE ANALYSIS. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). May 10, 1962. Contracts AT(10-1)-967 and AT(11-1)-1062. 111p. (IDO-19030(Vol.VI))

Data and information are presented concerning analyses of PL-2 transient performance, normal startup and shutdown procedures, and shield design. (J.R.D.)

30057 (CVNA-94) MECHANICAL DESIGN OF THE CVTR FUEL ASSEMBLY AND THERMAL BAFFLE. Topical Report. A. Slez, B. J. Balog, L. P. Hornak, and G. H. Eng (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1962. For Carolinas-Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). June 1962. Contract AT(30-1)-2289. 108p.

The fuel assembly and thermal baffle design for CVTR had to meet the conflicting requirements of minimum material in the core, and maximum strength and structural integrity. Careful study of several conceptual fuel assembly designs was carried out before a full-length fuel assembly with an integral baffle design and re-useable outer baffles was adopted. Analysis and component testing of clad specimens, prototype fuel rods, spacer wires, and thermal baffles were conducted. Stainless steel prototype assemblies, and finally, Zircaloy prototypes which were nearly identical to the design for in-plant use were built and tested out-of-pile at design temperature and pressure in prototype pressure tubes. A scaled down version of the CVTR pressure tube and fuel assembly was fabricated for in-pile testing. A seven rod Zircaloy fuel assembly and a Zircaloy pressure tube were inserted in the Westinghouse Test Reactor to evaluate the effects of radiation on the materials to be used in the CVTR pressure tube and fuel assembly. (auth)

30058 (CVNA-106) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., REPORT ON CVTR VAPOR CONTAINER TESTS. W. J. L. Kennedy and S. B. Jacobs (Stone and Webster Engineering Corp., Boston). Apr. 1962. Contract [AT(30-1)-2289]. 32p.

The vapor container for the Carolinas-Virginia Tube Reactor was tested to demonstrate its structural integrity and to determine that the leakage rate did not exceed the specified 0.1% of the contained volume per 24 hr. The overpressure test was conducted at 26.25 psi gage, which is 125% of the design pressure of 21 psi gage, for 1 hr. The leakage rate was found to be less than the specified as acceptable, and therefore the container leakage rate is considered satisfactory. (auth)

30059 (CVNA-115) THERMAL AND HYDRAULIC DESIGN OF THE CVTR FUEL ASSEMBLIES. Topical Report. A. A. Bishop, P. A. Nelson, and E. A. McCabe, Jr. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1962. For Carolinas-Virginia Nuclear Power Associates, Inc. Contract AT(30-1)-2289. 115p.

Each CVTR fuel assembly consists of 19 Zircaloy-clad 0.487-in. OD fuel rods spaced on an 0.6-in. triangular pitch. Wire is wrapped on a 15-in. helical pitch around each fuel rod except the center one. The wire wrap enhances coolant mixing and spaces the rods. Experimental data indicate that better than 70% mixing of the coolant occurs as it flows through the 8-ft long fuel assembly. The friction factor for a wire-wrapped fuel assembly decreases at a decreasing rate as the helical pitch of the wire is increased. At Reynolds numbers below 10^5, friction factors for a wire-wrap pitch of 15 in. are substantially the same as for flow through a smooth pipe at the corresponding Reynolds number. The initial net 100% power rating of all 72 fuel assemblies is 41 Mw at a maximum fuel rod rating of 14 kw/ft. (auth)

30060 (CVNA-116) CVTR PRESSURE TUBE FITTING DESIGN AND DEVELOPMENT. Topical Report. J. R. Reavis (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1962. For Carolinas-Virginia Nuclear Power Associates, Inc., Charlotte, N. C. Contract AT(30-1)-2289. 121p.

The CVTR contains 372 primary loop joints in the core portion of the plant. A design aim of one pound leakage/year/joint was established because of the high cost of heavy water, the large number of joints, and accelerated erosion of joints with higher leak rates. After parallel consideration of seal welded closures and several varieties of gasketed closures, a closure design based upon the Marman Conoseal gasket was selected. Connections utilizing this gasket were also developed for joining the Zircaloy and stainless steel portions of the pressure tube and the U-bend. An extensive test program was carried out which proved the effectiveness and reliability of the Conoseal design. (auth)

30061 (CVNA-119) CVTR PRESSURE TUBE MECHANICAL DESIGN AND DEVELOPMENT. Topical Report. G. H. Eng and J. R. Reavis (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). June 1962. For Carolinas Virginia Nuclear Power Associates Inc., Charlotte, N. C. Contract AT(30-1)-2289. 149p.

Design and development work is described which resulted in the final specification of the CVTR pressure tube assembly. The basis for the selection of the U-tube type pressure tube is presented. The functions and design conditions of the pressure tube assembly and components are given with pertinent stress analyses and the reasons for the selections of materials. Testing of two prototype pressure tube assemblies is discussed. (auth)

30062 (DLCS-5000662) MONTHLY OPERATING REPORT, JUNE 1962. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 39p.

The station was operated during the first four days of June at 70% reactor power to suppress a spontaneous axial xenon oscillation. From June 5 to 23 the station operated at reduced output because of the outage of two feedwater heaters. Following the return of the feedwater heaters to service, output was increased to, and maintained at, 60 Mw net for the remainder of the month. An operating incident occurred on June 14, which temporarily reduced the output for a very short period. Chemical conditions in the Reactor Coolant System, Reactor Plant auxiliary systems and the RWD Cooling Water System, were maintained within reference specification throughout the month. Reference water specifications were also maintained in the boilers under all operating conditions. Contamination levels were within specified limits in most areas of the Reactor Plant. There were isolated incidents of spot contamination in excess of limits; however, the contamination was confined to small areas, and routine cleaning methods were effective in reducing the levels to acceptable limits. Personnel radiation dosages were maintained within specified limits. Three tests were com-

pleted during this report period and four tests remained in progress. Three draft test procedures, one final test procedure, three test evaluations and nine preliminary reports were issued for Core I, Seed 3; one draft test procedure was issued for Core II. (auth)

30063 (DLCS-5000762) MONTHLY OPERATING REPORT, JULY 1962. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 48p.

Station operations during July were conducted in accordance with test program and system capacity requirements. Except for one four-day outage for physics testing and two periods when output was reduced due to the outage of the 1C feedwater heater, output was maintained at approximately 60 Mw net. During the shutdown for physics testing, the turbine-turning gear was inspected and repaired, and an operating check of all reactor coolant loop hydraulic valves was performed. The 1B reactor coolant loop hydraulic valves failed to reopen during this check, requiring that the loop be kept out of service pending repairs to the hydraulic valve pilot valve. Chemical conditions were satisfactorily maintained throughout the month in the Reactor Coolant System, Reactor Plant auxiliary systems, and in the RWDS Cooling Water System. Reference water specifications were maintained in the boilers under all operating conditions. No contamination was found in the non-nuclear portion of the Station and contamination levels in the Reactor Plant were generally within specified limits. Control measures in effect minimized the spread of contamination and, in all cases, confined the contamination to small areas. Routine cleaning methods effectively reduced the levels to within acceptable limits. All personnel radiation dosages were within specified limits. Fourteen tests were completed during July and two tests remained in progress. Four final test procedures and nine preliminary reports for Core I, Seed 3 and two draft test procedures for Core II, Seed 1 were issued. The Clean Room modification work was completed and the work on the Heat Dissipation System was 70% complete at the end of this month. Field work on the modification of the RWD level instrumentation was begun. (auth)

30064 (DP-745) HEAVY WATER MODERATED POWER REACTORS. Progress Report, May 1962. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). June 1962. Contract AT(07-2)-1. 34p.

Operation of the Heavy Water Components Test Reactor (HWCTR) at low power was continued for the purpose of conducting startup physics tests. During these tests, evidence was obtained of an apparent relationship between the hydraulics of the HWCTR system and the nuclear reactivity. A Zircaloy-clad tube of vibrationally compacted uranium oxide failed by buckling of the inner sheath during an irradiation test to low exposure in a Savannah River reactor. The failure is attributed to the buildup of excessive gas pressure within the tube. Buckling measurements were made on a lattice of 37-rod clusters of natural UO_2 in heavy water. In a comparative irradiation test, Zircaloy-3 exhibited 25% higher ductility than Zircaloy-2 both before and after irradiation to a fast neutron exposure of 5.1×10^{20} n/cm^2. (auth)

30065 (DP-755) HEAVY WATER MODERATED POWER REACTORS. Progress Report, June 1962. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours (E. I.) & Co. Atomic Energy Div., Wilmington, Del.). July 1962. Contract AT(07-2)-1. 38p.

Methods were devised for eliminating the changes in nuclear reactivity that accompanied changes in the operation of the main cooling system of the HWCTR. A brazing technique for sealing the ends of thin-walled Zircaloy-clad U fuel tubes is now being used in the fabrication of short specimens for irradiation testing. Remedial measures are being taken to prevent future tubes of uranium oxide from failing by collapse of the inner sheath, as did a recent tube during a low exposure Savannah River irradiation test. Further data were obtained on the burnout heat flux with forced flow of boiling water. (auth)

30066 (GA-2307) AN INTERIM REPORT ON THE TEMPERATURE COEFFICIENT OF THE 40-Mw(e) HTGR. P. U. Fischer and N. F. Wikner (General Atomic Div. General Dynamics Corp., San Diego, Calif.). July 14, 1961. Contract AT(04-3)-314. 74p.

The results of numerical calculations of the prompt and slow temperature coefficients of the 40-Mw(e) HTGR are presented; both these coefficients are negative at all times in life and at all temperatures. Considerable attention is given to the adequacy of the theoretical models, the nuclear data, and the computational procedures employed. These discussions give assurance that the analysis of the temperature coefficients is reliable. (auth)

30067 (GEAP-3884) HIGH POWER DENSITY DEVELOPMENT PROJECT. Sixth Quarterly Progress Report, July–September 1961. L. K. Holland (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 1961. Contract AT(04-3)-361. 58p.

The 24 high power density fuel bundles in VBWR continued to accumulate exposure. Average burnup is 1970 MWD/T for all elements. Two instrumented assemblies functioned in the reactor to an average exposure level of 1490 MWD/T. Operational testing of the instrumented assemblies was planned and conducted. Two-pass cold swaging was used to fabricate ten UO_2 fuel rods clad with stainless steel. Work on vibratory compaction of fuel rods by electromagnetic techniques was continued. Power cycling of swaged powder specimens was initiated. Design of the Big Rock developmental fuel assembly was completed. An economic study was performed to delineate how various parameters may affect fuel cycle cost. The heat transfer test components were completed and assembly of the nine-rod test section was started. Use of burnable poison in a limited number of fuel rods in a reactor core was studied. The effects of control rod pattern on power distribution and on irradiation were investigated. Specifications were written and issued for the data logging computer system. (M.C.G.)

30068 (GEMP-130) 630A MARITIME NUCLEAR STEAM GENERATOR. Progress Report No. 1. (General Electric Co. Flight Propulsion Laboratory Dept., Cincinnati). July 31, 1962. Contract AT(40-1)-2847. 116p.

Work on the 630A Maritime Nuclear Steam Generator Scoping Study is summarized. The objective of the program is to establish a specific 630A configuration and to develop specifications for components and test equipment. During the period, work was initiated in critical experiment design and fabrication; additional fuel and materials investigations; boiler-test design and fabrication; blower studies; design of component tests; nuclear, thermodynamic, mechanical and safety analysis; and test facility and equipment studies. Design of the critical experiment mockup and test equipment was completed and fabrication of the parts is approximately 50% complete. A rough draft of the critical experiment hazards report was completed. A fuel test in the ORR completed 876.5 hr of testing out of a planned 2200-hr test without indication of failure. The burnup was equivalent to about 6000 hr

of 630A operation. Damage to the capsule during refueling of the ORR caused termination of the test. The design of an MTR fuel-burnup test was completed and fabrication of the sample initiated. Ni-Cr fuel sheet and cladding stock are being tested for creep and oxidation properties at temperatures up to 1750°F and have accumulated times up to 5800 hr; no failures have occurred. These tests are continuing. Specimens of Ni-Cr were fabricated and will be tested to determine the effect of neutron irradiation. Cycle operating conditions with 1200°F reactor-discharge-air temperature were studied and found to be acceptable for the proposed maritime application. Increases in cycle efficiency above 30.2% appear to be possible and practical. Studies during the period indicate that an acceptable power distribution can be maintained through the life of the reactor and the maximum hot spot temperature and maximum burnup location would not coincide. Specifications for the fuel loading of the critical experiment are being prepared. Study of the pressure vessel resulted in selection of 304 SS. Containment studies indicated the practicality of designing the shield tank outer shell as part of the containment vessel. A blower scoping study subcontract was completed. The study verified the feasibility of the main and afterblower concept. Alternate shaft-seal designs were proposed. The design of a performance test for the two seal types has been initiated. The design of the boiler test from which control characteristics will be determined was completed and fabrication started. The decision was made that the Low Power Test Facility (LPTF) will be the site used for the critical experiment. A preliminary study of the power test facility requirements were completed. The study indicated that locating the facility adjacent to the LPTF would be operationally and economically feasible. (auth)

30069 (GNEC-211) STEAM ENVIRONMENT TESTING OF BONUS SUPERHEATER FUEL SUBASSEMBLIES. Terminal Report Under BONUS Activity 66-4. (General Nuclear Engineering Corp., Dunedin, Fla). June 30, 1962. Contract AT(40-1)-2674. 71p.

An experimental program was conducted on several BONUS fuel subassembly configurations to determine whether any unknown structural integrity problems were associated with the designs being evolved. Fuel subassemblies representative of an initial BONUS design (group I), and those representative of the final BONUS reference design (group II) were tested. It was concluded that the group I type subassembly was unsatisfactory whereas the group II type was generally satisfactory structurally except for braze joints. Other conclusions concerning fabrication and corrosion are included. (J.R.D.)

30070 (GNEC-241) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Twelfth Quarterly Progress Report, April–June 1962. (Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.). Contract AT(11-1)-795p. 117p.

The NUSU critical experiments were completed during the period and the final report on the critical experiment program with annular multitube fuel elements is currently in preparation. Lattice parameter measurements (disadvantage factors and U^{238} capture ratios) in the NUSU critical experiment were also completed; data are included. Measured and calculated eigenvalues were found to agree within 1% for both uniform cores and cores containing heterogeneities such as water channels and cylindrical rods. Application of the engineering physics method developed for calculating control rod effectiveness to the NUSU reference design essentially substantiated the original plan. Results of a study using this method also revealed that the design is very near optimum for use in a large power reactor. Development of alternate cladding materials is reported. Weld test results are reported on Inconel-to-Inconel, Hastelloy-X-to-Inconel, and stainless steel-to-Inconel. A study was initiated to evaluate the state-of-the-art of superheat reactor core physics analyses. The study was initiated to find the range of applicability of various calculation packages. Another study was initiated on the design, development, and fabrication of annular multitube fuel elements. (J.R.D.)

30071 (HPR-19) TEMPERATURE REACTIVITY EFFECTS IN HBWR WITH THE FIRST FUEL CHARGE. F. W. A. Habermann and N. Standal (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). May 1962. 40p.

Temperature reactivity coefficients for the just critical HBWR with a natural-U fuel charge were measured. The moderator temperature ranged from T = 50 to 150°C. The uniform moderator temperature coefficient was found to increase from −23.1 pcm/°C at T = 50 to −31.4 pcm/°C at T = 150°C. The material buckling (Bm^2), as a function of temperature, was obtained from measurements of critical water levels. In the above-mentioned temperature interval, the temperature coefficient of Bm^2 is of the order of $-0.012 m^{-2}/°C$. The coefficient is found to increase slightly with increasing temperature. The water level reactivity coefficient was measured at three different temperatures above T = 100°C. From the analysis of these experiments, together with results which have earlier been obtained at T = 20°C, a measured temperature dependence of M^2/k_∞ was evaluated. Finally, the temperature effect on the reactivity worth of a control rod was determined. This was obtained by comparing measured calibration curves at T = 20°C and T = 150°C. The effectiveness of the rod was found to increase by 15 ± 4%. The measurements mentioned above were compared with theoretical calculations on the basis of two-group diffusion theory for the equivalent bare core. The calculated temperature effects do not agree with the measurements, and the comparison seems to indicate an incorrect description of the temperature dependence of the lattice parameters. (auth)

30072 (HPR-24) HBWR QUARTERLY PROGRESS REPORT, JANUARY TO MARCH 1962. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). 63p.

The reactor was taken to critical with a 24-element core at a water level of 172.5 cm at 34°C. A later approach at the same temperature with 100 elements yielded data indicating a critical water level of 106.4 cm. D_2O inventory data show an annual loss during the first three years of operation of 1.2% with a degradation of 0.02%. The maximum excess reactivity was estimated at 18.4 ± 0.9% for a full core loading. Experiments in NORA using simulated HBWR lattices yielded data which indicated that the void reactivity effects associated with the partial displacement of coolant are negative throughout the full lattice. Experiments under second full charge conditions showed that the burnout heat flux increases with steam quality and decreases with test section length in such a way that it is critically dependent on heat flux profile. The majority of the engineering modifications to the reactor plant were completed during the report period and various components and circuits were cold-commissioned. Data obtained from the purification circuit show a corrosion rate of 5% during first charge operations. (J.R.D.)

30073 (HW-67102) REACTIVITY MEASUREMENTS IN THE PRTR. V. Wayne Gustafson (General Electric Co.

Hanford Atomic Products Operation, Richland, Wash.). Oct. 18, 1960. Contract AT(45-1)-1350. 9p.

A method for determining the reactivity in the PRTR is presented. Kinetics of the system are discussed and a method of making reactivity measurement by measuring a positive period with the reactor supercritical is described. (J.R.D.)

30074 (HW-67246) TWO DIMENSIONAL FLUX AND POWER CALCULATIONS FOR THE PRTR. R. E. Peterson and W. H. Wolf (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 31, 1960. Contract AT(45-1)-1350. 23p.

Calculations of the neutron flux and power distribution in the Plutonium Recycle Test Reactor utilizing a two-dimensional, three energy group model were completed. Previous calculations of this nature were carried out in one dimension only and separability of the vertical and radial distributions was necessarily assumed. A study is described which, in addition to eliminating this assumption, includes a detailed analysis of the dump chamber and end effects. These calculations were performed with the multigroup, two-dimensional diffusion code 9 ANGIE. Nuclear data utilized in the code were taken, for the most part, from Henderson's compilation, which is given. Two different fuel loadings were investigated, corresponding to probable minimum and maximum spike loadings respectively. Also the effects of moderator level, shim insertion, Pu burnout, and radial reflector on flux and power distribution were studied. A summary of case descriptions is included. The moderator levels were selected to correspond to PRTR critical experiments. Variation in heat output of the UO_2 is expected to be small due to in-situ fissioning of Pu at higher exposures and therefore was not included in this study. (auth)

30075 (HW-70158(Pt.I)) INVESTIGATION OF PLUTONIUM-BEARING FUEL ELEMENTS FOR THE PLUTONIUM RECYCLE TEST REACTOR. PART I. W. J. Bailey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 98p.

Ten of the irradiation experiments with Pu-containing fuel elements which have been or are being conducted in support of the PRTR are described. Fuel elements containing Al–Pu and Al-12 Si–Pu alloys with 1.65 to 20 wt % Pu and high- and low-density, UO_2–PuO_2 pellets with 0.0259 to 7.45 at. % PuO_2 were fabricated and irradiated. Eight of the irradiation tests were performed in the Materials Testing Reactor (MTR) with capsules containing fuel cores which were 0.5 in. in dia. and 2.0 in. in length. Two tests were carried out in the high-temperature and pressure loops at the KER Facility at HAPO. One test employed a four-rod cluster element about ten in. long and one a seven-rod cluster which was 28 in. long. In both clusters the fuel cores were 0.5 in. in dia. The fuel element cladding was either Zircaloy-2 or Zircaloy-3 and had an outside dia. of $^{9}/_{16}$ in. and a wall thickness of 0.030 in. All fuel elements employed in the tests performed satisfactorily. One irradiated high-density UO_2–PuO_2 capsule failed when it was inadvertently placed in a neutron flux 11 times the specified value. Except for the ruptured specimen, all pieces were in good condition and exhibited no excessive or unusual corrosion. Core-core bonding was noted on one Al–Pu alloy fuel rod and core-end cap bonding on one Al–Si–Pu alloy rod. From the limited number of experiments and observations it was concluded that the Al–Pu alloys, Al–Si–Pu alloys, and UO_2–PuO_2 compositions tested all exhibited good radiation behavior in the ranges of interest to the PRTR. For the same temperature range (650 to 850°F), the Al–Pu alloys appear to be more resistant to deformation than the Al–Si–Pu alloys. In both alloy cases, resistance to deformation tends to increase with increasing Pu content. The volume changes appear to be more sensitive to core temperature than to exposure. The cluster experiments indicate that the PRTR element design is sound and will perform well in high-pressure and temperature water. The oxide specimens received exposures on the order of 1000 to 2000 Mwd/t. Grain growth was noted in one high-density piece and a central void formation was observed in two, low-density pieces. The fission gas release was up to 3% in the high-density oxides and to about 22% in the low-density specimens. The degree of fuel core cracking appears to decrease with increasing Pu content. Capsules from these tests are currently being irradiated to higher exposures (5000 Mwd/t). The oxide capsule which failed operated in the high flux position for six days before it was removed. All of the oxide was missing and a marked core-end cap reaction had occurred. The examination of the thin-wall, extruded Zircaloy tubing indicated that all material must be carefully inspected for flaws, especially on the inner surface. It is recommended that an ultrasonic technique be employed. (auth)

30076 (HW-70880) PRTR FUEL ELEMENT EXAMINATION FACILITY OPERATIONS MANUAL. W. S. Kelly and R. L. Straley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 47p.

The manual contains operational and design information concerning the facility which is in a 4 × 6 × 12 ft well in the floor of the reactor wall. Contained in the well is mechanical and optical equipment suitable for handling, photographing, and viewing fuel elements and process tubes irradiated in the PRTR. (J.R.D.)

30077 (HW-74571) HANFORD STUDIES EXECUTED FOR THE USAEC-AECL COOPERATIVE PROGRAM ON DEVELOPMENT OF HEAVY WATER MODERATED POWER REACTORS. Monthly Progress Report, July 1962 F. W. Albaugh, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 10, 1962. Contract [AT(45-1)-1350]. 5p.

Futher examination was made of an electrically heated model of a 0.050-in. spaced 19-rod bundle fuel element previously used to obtain boiling burnout points. It was found that the inner seven rods had experienced film boiling conditions over a considerable portion of their length. Ultrasonic response measurements were continued on elevating drilled holes for use as bench-marks for production testing of sheath tubing. Transducer studies were made using a set of holes drilled in Zircaloy tubing, to compare Lamb-wave sound fields in tubing with the fields measured by reflections from ball-bearings. Instrumentation evaluation involved transmitted ultrasound frequency and comparison of commercial units. Fundamental studies to make clear the physical picture of Lamb-wave propagation behavior were continued. (M.C.G.)

30078 (MND-M-1824) PM-1 NUCLEAR POWER PLANT PROGRAM. 13th Quarterly Progress Report, March 1, 1962 to May 31, 1962. (Martin Co. Nuclear Div., Baltimore). June 8, 1962. Contract AT(30-1)-2345. 40p.

The design, development, fabrication, installation, initial testing, and operation of a prepackaged, air-transportable nuclear power plant, the PM-1, are described and discussed. The specified output of the system is one mega-

watt(e) and seven million Btu/hr of heat. The principal efforts during the thirteenth quarter were concerned with plant testing. (auth)

30079 (MND-M-1916) REACTOR FLOW STUDIES QUARTER SCALE FLOW MODEL TESTS. PM-1 TASK 2, Subtask 2.3. W. J. Taylor and I. Starr (Martin Co. Nuclear Div., Baltimore). Apr. 1960. Contract AT(30-1)-2345. 160p.

Activities to determine the coolant flow pattern in the PM-1 reactor vessel and its internal components are reported. A 1/4-scale flow-model of the PM-1 vessel configuration was fabricated and tested to observe the flow distributions and pressure drops associated with this design. Flow distribution in the inlet water box was found to be independent of velocity and Reynolds number in the range tested. A pressure recovery from the kinetic energy of the inlet flow was observed. This caused a minimum flow from the water box at the inlet side of the vessel and a maximum flow at the opposite side. The flow variation resulting from the water box was reduced by the characteristics of the flow annulus formed by the thermal shields. The overall pressure drop measured from inlet to outlet was 23 ft of head as compared with the predicted value of 21 ft. (J.R.D.)

30080 (MND-M-2343) REACTOR FLOW STUDIES FUEL TUBE BUNDLE FLOW TESTS. PM-1 TASK 2, Subtask 2.3. W. J. Taylor, R. Baer, and M. P. Norin (Martin Co. Nuclear Div., Baltimore). July 1960. Contract AT(30-1)-2345. 69p.

Fuel tube bundle flow tests were performed to obtain data on the reactor core prior to the fabrication of a full scale model. Water flow tests were run at relatively low pressures and temperatures in an effort to determine the fuel tube inlet orifice diameter which regulates the flow distribution such that 48% of the total flow passes through the fuel tubes. Flow ratios, which ranged from 0.996 to 1.119, were higher than the design value of 0.923. Results of other flow tests, at low pressure, performed on tube bundles which simulated a portion of the PM-1 core indicated the magnitude of flow blockage caused by core support members. Results were obtained with two different sized bars used to simulate support members. (J.R.D.)

30081 (MND-M-2824) PM-1 NUCLEAR POWER PLANT TOPICAL REPORT—CONTROL ROD DRIVE MECHANISMS. Peter J. Karnoski, Jr. (Martin Co. Nuclear Div., Baltimore). May 1962. Contract AT(30-1)-2345. 86p.

The development of the PM-1 control rod drive mechanism from its design stage, through testing, to installation and operation with the live core is described. The drive mechanism is a friction-type magnetic jack. The mechanisms are fail safe; in case of a power failure, scram action results from a combination of gravity and the driving force of a scram spring. Signal pulses, necessary power, and position indication are provided by a solid-state power supply and control system. Maximum use was made of modular circuitry and drawer-contained components to permit easy access to and maintenance of the electronic system, including removable drive coil and position indicator transmitter assemblies. All mechanical functions, such as installation, latching of the control rods, and removal of the mechanisms, are performed manually through shield water by means of special handling tools. (N.W.R.)

30082 (MND-MD-2560-4) PM RESEARCH AND DEVELOPMENT PROGRAM 4TH QUARTERLY PROGRESS REPORT, JANUARY 1, 1962 TO MARCH 31, 1962. C. Eichelbinger (Martin Co. Nuclear Div., Baltimore). Contract AT(30-1)-2706. 148p.

Progress in the PM research and development program is reported. Core design and development continued for PM-1 plant. Evaluation of spherical and coated UO_2 fuel particles continued. Tensile, hardness, and density testing of cermet matrix material was performed which revealed desirable strength and ductility properties in low Si 304 and 318 stainless steels. The finger-type control rod Test 1 series was completed. Research plans for irradiation testing, critical experiments, and zero power testing were completed. The experimental portion of the two-phase pressure drop program associated with heat transfer was completed. Correlation of resulting data was successful. (J.R.D.)

30083 (NAA-SR-4384) INTERIM REPORT ON HNPF MODERATOR ELEMENT DEVELOPMENT. L. Newcomb and H. L. Sujata (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Aug. 15, 1962. Contract AT(11-1)-Gen-8. 49p.

Moderator element sheaths for the Hallam Nuclear Power Facility were subjected to mechanically and thermally induced compressive loads. Analysis of the results showed that the sheath buckling could be described by a modified "effective width" concept used for evaluating thin-plate buckling. Comparisons made between the theoretical and the experimental results showed reasonable agreement. Discussion of the problems encountered in the development of fabrication techniques for the moderator elements and the methods of solution are also presented. (auth)

30084 (NAA-SR-7135) DISTRIBUTION OF ENRICHED UO_2 IN PELLETS PREPARED FROM POWDERS ENRICHED BY BLENDING. F. D. Rosen and T. E. Luebben (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). July 15, 1962. Contract AT(11-1)-GEN-8. 30p.

Blending with enriched UO_2 was demonstrated to be a technically feasible method for re-enriching spent, UO_2 reactor fuels. Mixing of powders containing small and similarly sized particles yielded fuel with the enriched particles well dispersed in the finished pellets. An autoradiographic technique, based on alpha particle emission, was used to show the distribution of enriched UO_2 in the sintered pellets. (auth)

30085 (NMI-7249) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period March 1, 1962-March 31, 1962. S. Isserow, R. W. Anderson, A. B. Bremer, D. M. Davies, W. J. Richmond, and W. L. Larson (Nuclear Metals, Inc., Concord, Mass.). June 1962. Contract [AT(30-1)-1565]. 46p.

Evaluation was completed on the prototype for the enriched U inner tubes. The uniformity of the outside cladding was determined, and the results support the decision to use, as cladding stock for the enriched tubes, only Zircaloy initially forged at temperatures below 1650°F. Three outer tubes were coextruded with cores prepared by a relatively simple and economical process requiring only a single alpha extrusion. The smoothness of the core-cladding interfaces showed that this process is adequate for refinement of the U grains. The program to produce fuel tubes containing cores of various U alloys for irradiation in the HWCTR was resumed. Components for the next two extrusion billets, containing U-1 wt. % Si and U-1.5 wt. % Mo cores, are being prepared. The equipment for sealing the ends of HWCTR tubes by brazing was modified to accept tube sections 6 ft long. Several brazed end

closures were made with the modified equipment. As part of a continuing effort to develop a metallic fuel with improved irradiation behavior, several alloy systems were studied metallographically and by hot hardness testing. A sub-micron precipitate can be produced by proper heat treatment in U-0.08 wt. % Si, U-0.3 wt. % Al-0.5 wt. % Si system and in the recently developed U-0.3 wt. % Al-0.18 wt. % Si system. The data suggest that alpha U has finer grains if its transformation from beta occurs at lower temperatures than usual. Hot hardness studies of as-cast U alloys containing 0.15, 0.4, 1.0 and 1.5 wt. % Mo showed that all of the alloys are harder than unalloyed U. The 0.4 wt. % Mo alloy is consistently harder than the other compositions. Above 500°C, the hardnesses of the alloys tend to fall to the level of the 0.15 wt. % Mo solid solution alloy. The hardness transition temperature of all the alloys is increased to the 450 to 500°C range. Tests on wrought U-1.5 wt. % Mo heat-treated to five different conditions show that a wide variety of microstructures and hardness properties can be developed. These wrought materials did not exhibit the higher hardness transition temperature observed for the cast alloys. (auth)

30086 (NMI-7250) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period April 1, 1962–April 30, 1962. S. Isserow, R. W. Anderson, and W. J. Richmond (Nuclear Metals, Inc., Concord, Mass.). June 4, 1962. Contract [AT(30-1)-1565]. 27p.

Two outer HWCTR tubes containing U-1 wt % Si and U-1.5 wt % Mo cores were extruded. The U-1 wt % Si tube will be processed as a full length tube with integral end seals. The U-1.5 wt % Mo tube will be used to obtain short irradiation specimens with brazed end seals. Studies of several dilute U alloys were continued in the program to develop a fuel with improved irradiation behavior at high temperatures. A suitable heat treatment of billet-sized sections of U-0.3 wt % Al-0.18 wt % Si has yet to be developed. Additional stability tests of U-0.08 wt % Si in the beta-quenched condition show that the room temperature hardness is not sensitive to aging at 600°C, but the elevated temperature hardnesses are markedly reduced within 8 hours. The softening is consistent with changes in the microstructure. Uranium containing 350 ppm Fe, 1000 ppm Al, and 700 ppm C was included in this program, in light of the British observation that such an alloy in the cast condition has improved resistance to swelling. Experimental extrusions of this alloy have demonstrated that a process resembling the upset-extrude sequence has to be used to ensure smooth core-cladding interfaces. The alloy content does not raise the extrusion constant significantly at 1100°F. Beta quenching of the extruded alloy produces fine grain size, and a fine precipitate is formed uniformly through the matrix; apparently oil quenching does not suppress the precipitation of the alloy content. Hot hardness testing of extruded specimens of the U–Fe–Al alloy that was beta quenched and then aged at 600°C for 1, 24, and 100 hours shows that the maximum elevated temperature hardness is obtained in the beta-quenched condition. Aging at 600°C causes significant decreases in hardnesses; the maximum reduction of hardness has already occurred after only 24 hours. Evaluation of extruded tube sections of ingot and dingot U containing additions of Fe, Si, and/or Al to 100–150 ppm showed that these additions markedly affect the properties of U. The hardness of U in the beta-quenched condition is increased as much as 50% in the 200 to 600°C range; however, annealing at 600°C completely erases this effect. It is believed that this hardness behavior results from dispersion hardening rather than solution hardening. The dispersed phase may be related to the "delta phase" that is used for control of grain size. The very dilute alloy additions also retard recrystallization in both the ingot and dingot U. The effects of subtle differences in composition and heat treatment (such as beta treatment) may be related to the reported differences in irradiation behavior of "unalloyed U." (auth)

30087 (NMI-7252) POWER REACTOR PROGRAM. Progress Report to Savannah River Operations Office, United States Atomic Energy Commission for the Period June 1, 1962–June 30, 1962. S. Isserow, R. W. Anderson, W. J. Richmond, and D. M. Davies (Nuclear Metals, Inc., Concord, Mass.). July 25, 1962. Contract [AT(30-1)-1565]. 15p.

The outer tube containing a U–1 wt % Si core was successfully processed as an irradiation candidate for the HWCTR. The tube meets all specifications and is ready for shipment to SRL. To guide the selection of a heat treatment for the capsule irradiation specimens containing cores of U–350 ppm Fe–900 ppm Al, the alloy was evaluated after various treatments. The heat treatment selected consists of a beta treatment in 730°C salt for 15 minutes, oil quenching, reheating in 500°C salt for one hour and then air cooling. Heat treatments including quenching from the gamma phase resulted in cracking of the alloy and deterioration of the core-cladding bond. Twelve specimens containing the U–350 ppm Fe–900 ppm Al cores were completed and sent to SRL for test irradiation in lead-insulated capsules. The processing of these specimens included coextrusion of tube stock, sealing of the specimens by brazing, heat treatment and evaluation. The quality of the tubes was demonstrated by destructive tests of sections adjoining the blanks used for the irradiation specimens. (auth)

30088 (NP-11909) NERO DEVELOPMENT PROGRAMME SEMIANNUAL REPORT, JULY 1, 1961 TO DECEMBER 31, 1961. (Reactor Centrum Nederland, The Hague). 59p.

The status of Nero reactor design at the end of the report period is described. Work in the various fields of design are reported in chapters on critical experiments, incorporation of burnable poison in UO_2, irradiation experiments, corrosion research, general design and calculations, stress analysis of pressure vessel and cover, steam generator performance testing, control rod drives, development of special welding techniques, control rod materials and construction, pressurizer performance, pumps and accessories, heat extraction from the core, hydraulic parameter determination, and shielding design. (J.R.D.)

30089 (NP-11912) O.E.C.D. HALDEN REACTOR PROJECT. Third Annual Report. (Norway. Institutt for Atomenergi. OECD Halden Reaktor Prosjekt). 1961. 137p.

During the report period, the high-temperature low-power phase of the experimental program was completed, also the first full charge was removed and the second charge was installed. The experiments performed led to a detailed characterization of plant dynamics. Included are details of the research program, reactor operation, plant modifications, fuel charge changes, reactor safety and radiation protection and administration. A reactor data summary is also included. (J.R.D.)

30090 (NYO-4815) EVALUATION OF PROPOSED KRYPTON–XENON ADSORPTION SYSTEM DESIGNS FOR THE PL-2 REACTOR. George C. Krusen, II, and Leslie Silverman (Harvard Univ., Boston. Air Cleaning Lab.). Aug. 3, 1962. Contract AT(30-1)-841. 88p.

The proposed design by the Mine Safety Appliance (MSA) Research Corp. of a rare gas handling system for the PL-2 reactor was examined in detail. This system provides for partial removal of radioactive Xe and Kr from air by low temperature (–90°F) adsorption on activated C. The estimated off-gas flow treated is five SCFM. Adsorption is followed by air dilution of the remaining activity. The proposed design was examined to determine whether the AEC-Army Reactor Branch specifications for the resultant activity could be met and whether the size and weight of the unit could be materially reduced. A parallel search of the literature was made to determine whether other methods could be used to effect the separation. Some were found, but the only one of immediate interest involves condensing the Kr and Xe on activated C at liquid N_2 temperature. Such a cryogenic system for removing these inert gases from a 2 SCFM recirculating flow of H_2 was installed for operation on the N. S. Savannah. On the basis of available data and calculations, the effluent from the MSA adsorber will not meet the design activity because there is not enough dilution air to attain a level of 8×10^{-13} μc/ml for Kr^{85}. The resultant activity was 38% greater. Added dilution capacity would correct this deficiency. MSA research personnel, in their design considerations, apparently neglected Kr^{85} released directly from the fuel elements. Their only concern was with the Kr^{85} which is a daughter product of Kr^{85m}. Neither will the effluent meet release criteria if 1% of the equilibrium activity of the PL-2 reactor (7.48 MW) is released to the adsorber over a period of 1 min while the flow of carrier gas remains undiminished. Recommendations for further research are included. (auth)

30091 (ORNL-1915) INVESTIGATION OF MATERIALS FOR A WATER COOLED AND MODERATED REACTOR. Louis Scheib. (Oak Ridge National Lab., Tenn.). Aug. 1954. Contract W-7405-eng-26. 177p.

An investigation of the materials for use in the water-moderated and cooled Army Package Power Reactor (APPR) operating at about 500°F was made. The available literature was analyzed, and the results of the different investigators were compared and averaged. Twenty different materials, including stainless steels, nickel alloys, Stellites and others, were investigated from the point of view of physical properties, susceptibility to radiation damage, and corrosion resistance. Corrosion rates were established for all the materials under various conditions, such as irradiation, flow, weld, stress, and various water conditions. Type-304 stainless steel was selected as the basic structural material. Operating conditions, to maintain minimum corrosion, were established also. (auth)

30092 (ORNL-TM-314) FUEL CYCLES FOR AN 800 Mw(t) PEBBLE-BED REACTOR. R. S. Carlsmith (Oak Ridge National Lab., Tenn.). Aug. 8, 1962. Contract [W-7405-eng-26]. 19p.

Reactivity lifetime calculations were made for an 800-Mw(t) pebble-bed reactor on the basis of a batch-fueling cycle, a once-through equilibrium cycle, and a graded-exposure equilibrium cycle. The maximum lifetime, obtained with the graded-exposure equilibrium cycle, was 1.41 fissions per initial fissionable atom. In this case the conversion ratio was 0.62 and the neutron leakage from the core was 0.078. The same fuel composition gave 1.29 fissions per initial fissionable atom on a once-through equilibrium cycle and 0.92 fissions per initial fissionable atom on a batch cycle. (auth)

30093 (SRO-71) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JULY 1962. (Savannah River Operations Office, AEC). 12p.

Research and development are reported in the AEC/AECL cooperative program on the CANDU refueling machine and on Zr technology. Du Pont work in physics, reactor engineering and metallurgy are also reported along with work at Columbia University on burnout, activities at the VBWR on burnup, and irradiation tests at Nuclear Metals. Test and development work at the HWCTR are summarized, and information concerning development of the CVTR is included. (J.R.D.)

30094 (SY-5396-R1) SPUR POWER SYSTEM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1962. (AiResearch Mfg. Co. Div. of Garrett Corp., Phoenix, Ariz.). July 15, 1962. Contract AF33 (657)-8954. 75p.

Research and development activities on the Space Power Unit Reactor (SPUR) are reported. The power system will consist of a reactor, a thermal-electric-energy mechanical converter, a waste heat rejector, and other auxiliary equipment. The conversion system will be of a closed-cycle dynamic type which is capable of unattended operations under specified conditions. Preliminary work in the various development areas by the prime contractor and subcontractors is reported. (J.R.D.)

30095 (TID-8518(Add.)) CIVILIAN POWER REACTOR PROGRAM. PART III. CORE-PARAMETER STUDIES FOR SELECTED REACTOR TYPES. (Atomic Energy Commission, Washington, D. C. and Jackson and Moreland, Inc., Boston). [1959]. 73p.

A report is presented to provide a tool for evaluating the relative economic incentives for changing reactor core parameters. The cost relations are shown in terms of differential cost in lieu of total cost. A total cost for each reactor described is included so that power costs for a specified set of parameters can be obtained. A description is also included concerning 5 reactor types considered along with a discussion of the effects on power costs of varying the significant core parameters. A listing of basic references is given. (J.R.D.)

30096 (TID-15329) NUCLEAR POWER AND UTILITY SYSTEMS. Milton F. Searl and George Y. Jordy (Division of Operations Analysis and Forecasting, AEC). Apr. 1962. 103p.

Various aspects of integrating nuclear power plants into utility systems comprised mainly of fossil-fueled steam-electric plants are considered. The location, financing, and operation of nuclear plants presently operable or under construction and the characteristics of the utility systems of which these plants are a part are of primary interest. Data are presented in such a manner as to facilitate comparison between the various nuclear power plants discussed and between the utility systems involved. (auth)

30097 (UNC-5012) EXTENDED COMPARISON OF CALCULATED AND MEASURED REACTIVITIES FOR D_2O-MODERATED LATTICES. R. Sullivan and H. Soodak (United Nuclear Corp. Development Div., White Plains, N. Y.). May 15, 1962. Contract AT(30-1)-2836. 36p.

An extended comparison of calculated and measured values of B^2 and k_∞ is presented for D_2O-moderated lattices with rod-type fuel elements employing the method of subcell collision probabilities described in a previous report. Comparisons with approximately 100 measurements gave buckling agreement within 5% and k_∞ agreement within 1%, except in a few cases for which the calculational method has known deficiencies. The calculation method is shown to be useful for predicting reactivity changes due to changes in one or more lattice features. Comparison with 20 measurements on the effect of total or partial voiding of the coolant channel shows that the calculation correctly

predicts the sign and magnitude of the effect in all cases. The possibility of tailoring the coolant void coefficient in sizing the coolant tube is noted. (auth)

30098 (WAPD-MRP-98) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, April 24, 1962 to June 23, 1962. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 140p.

PWR Core 2 blanket thermal performance was re-evaluated and improved, utilizing values for the thermal conductivity of natural UO_2 which include experimentally derived effects of temperature and depletion of conductivity. The end channel of the blanket subassembly was redesigned in view of fabrication experience and new thermal information. Processing of PWR-2 blanket fuel elements is approximately 97% complete with an overall acceptance yield of 96% being maintained. Processing of seed fuel elements is continuing satisfactorily. A technique was developed to utilize seed elements with surface bulges which were the major cause of rejection. Special oxide proof test assembly (SOAP II) is proceeding on schedule for installation at Shippingport during Seed 3 and 4 refueling. A problem in the design of the poison fuel elements developed in relation to the eutectic melting in the Inconel ringlet areas during seed subassembly welding. A development program was initiated to evaluate modification to the existing fuel element design and subassembly welding technique. In PWR Core 1 work, a re-evaluation of PWR Core 1 Seed 3 thermal limits for the last half of core life confirmed that Seed 3 can deliver 60 Mw_e for the remainder of life without exceeding safe operating conditions. The protective coating test patches in the Deep Pit were inspected after more than a year of submersion in demineralized water. Several test patches did not contain blisters or pinholes and had a good appearance. A metallurgical report on a tube extracted from the coolant charging system heat exchanger concluded that the heat exchanger tubes had failed owing to chloride stress corrosion. Recommendations were made that the stainless steel tubes and tube sheet be replaced with Inconel tubes and tube sheet which will be capable of withstanding chemical attack of Ohio River water containing high amounts of chlorides. It was indicated that radiation levels of the main loop piping and associated components increased from crud released to the reactor vessel during the first and second refueling. Recommendations were made to measure the crud released during Seed 3 and 4 refueling and to determine whether filtration of reactor vessel water is an effective means of reducing plant radiation levels following refueling. The feasibility of using electrodecontamination procedures on pump volutes was demonstrated on the Allis-Chalmers pump volute removed from "D" Loop, indicating 90% of the activity was removed. Three timesteps of the detailed three-dimensional depletion calculation of Core 1 were performed, with results which indicate no significant improvement over the results of the less detailed three-dimensional depletion calculation. Consequently, no further timesteps are planned at present. A digital computer program was completed which calculates the fission product poison buildup including the effects of radioactivity decay and can treat both seed and blanket conditions. Numerical results were obtained for both seed and blanket regions. These include additional poisons, based on recent experimental work, that have not been included in previous studies. During the resumption of full power at 4050 EFPH, a spontaneous fluctuation of the controlling rod position was observed. This behavior was similar to that observed during Seed 2 lifetime after a similar shutdown for zero power physics testing. For the Irradiated Fuel Reactivity Experiments, the analytical model for the interpretation of reactivity measurements was modified to incorporate both Doppler Broadening in the self-shielded resonance integrals and the augmentation of the fast flux introduced by fission within a sample. Two PWR-1 blanket type rods in the B4-10 loop test which failed after exposures of 13.9×10^{20} fission/cc are being examined. Preliminary conclusions based on incomplete data indicate that one of the rods developed a cladding defect about 60 days prior to removal from the loop. As a result of this, severe hydriding of the cladding occurred resulting in embrittlement and cracking of the cladding. A comparison of rupture pressure data on machined compartments with those of MCO compartments containing up to 0.006 in. of fuel-clad reaction zone indicates good agreement. It may be concluded that fuel-clad reaction to the extent indicated does not affect rupture pressure. (auth)

30099 (WAPD-PWR-TE-86) RADIATION LEVELS OF THE PRIMARY SYSTEM OF PWR. Test Evaluation, DLCS-36501. W. Lechnick (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1962. Contract AT(11-1)-GEN-14. 21p.

Radiation levels of the PWR hairpin loop are in general indicative of the trend of overall plant contamination behavior. The highest rate of activity buildup occurs during initial exposure of the loop piping to coolant flow, indicating that the buildup mechanism may be related to corrosion rate. Co^{60} activity on the hairpin loop is below that observed on the main loop piping, probably because of a distance effect. There is some indication that this spread in activity is decreasing with time in operation. Specific activity of the Co^{60} in the hairpin loop apparently attained an equilibrium value during early Core 1, Seed 2 life. (auth)

30100 (WAPD-PWR-TE-140) EVALUATION OF CORE THERMAL AND HYDRAULIC DATA. PWR CORE 1 SEED 3, START-UP TO MID-LIFE. DLCS-36201, DLCS-24301, AND DLCS-35801. [Period Covered] October 1961 - March 1962. M. G. Friedman and L. M. Swartz (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1962. Contract AT(11-1)-Gen-14. 91p.

Thirty-five Seed 3 exit water thermocouples were used to monitor power from individual fuel assemblies. The data collected from the thermocouples during the first half of PWR Seed 3 life when converted to assembly power fractions show good agreement with predictions. Predictions are based on a three-dimensional calculation using the recently completed TNT code written for the Philco 2000 computer. Temperature measurements will continue as Seed 3 is depleted to permit a full lifetime evaluation of seed-blanket power sharing calculational methods. The thermocouple calibration information is included for reference. These data are used to correct the thermocouple output of the DAS which, in turn, is used to process core thermal data. Comparative evaluation of calibrations is also helpful in identifying instrumentation system irregularities. Evidence is also presented that the time-dependent changes in core flow and reactor pressure drop are too small to be detected by the installed instrumentation. It is concluded that measured reactor characteristics show satisfactory agreement with predicted values. (auth)

30101 (WAPD-PWR-TE-142) MANUALLY OPERATED REACTOR COOLANT LOOP STOP VALVE TEST. [Test Evaluation] DLCS 39501. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 31, 1962. Contract AT(11-1)-Gen-14. 7p.

The subject test was proposed to determine operational difficulties experienced with manually operated reactor coolant loop stop valves. The test primarily consisted of operating a stop valve under various pressures while noting pressures, temperatures, and ease of valve operation. From the recorded test data and operational observations, it was concluded that loop pressure, valve cavity pressure, and the bearing position of the handwheel manual operator were the controlling factors which affect the operation of the valves. Recommendations for correcting the operational difficulties were incorporated in the test evaluation. (auth)

30102 (WAPD-PWR-TE-143) POWER COASTDOWN FOLLOWING REACTOR SCRAM, DLCS-3440201. Test Evaluation. L. M. Swartz (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 5, 1962. Contract AT-11-1-GEN-14. 11p.

Power coastdown data obtained during scram of PWR Core 1 from full power are evaluated. Good agreement between prediction and measurement of power coastdown is found. Prediction and measurement of core thermal data during the power coastdown are also found to be in agreement as to trend but additional work would be required to make the data corrections necessary for precise data comparisons. (auth)

30103 (WCAP-1737) PRELIMINARY CORE DESIGN OF A 500 KWe THERMOELECTRIC REACTOR. R. A. Markley and E. G. Schwartz (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Mar. 1961. Contract AT(30-3)-500. 38p.

Reactor arrangement studies conducted to examine the capabilities and problems of a power generation system consisting of a fission heat source and a thermoelectric conversion device are reported. The reactor system chosen for study was light-water cooled and moderated with a power output of 500 kw(e). Study results indicate that the application of such systems is limited to specialized functions in which the unique advantages of a compact, reliable, low-maintenance static conversion system override the penalities of cost and low efficiency. (J.R.D.)

30104 (WCAP-4127) CVTR PROJECT, CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC. MONTHLY PROGRESS REPORT, JULY 1962. (Westinghouse Electric Corp., Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 8p.

Progress made during the past month included: hydrogen analysis of in-pile loop, determination of reactor parameters by rod perturbation techniques, hazards report, and metallurgical examination of CVTR components. Orders for various components and instruments are reported. (N.W.R.)

30105 (AEC-tr-5244) STUDY OF THE UNDERGROUND CONFINEMENT OF THE EXPERIMENTAL NUCLEAR POWER PLANT AT LUCENS (SWITZERLAND). E. Binggeli, A. Sutter, and P. Verstraete. Translated from a Paper Presented at the Symposium on Reactor Safety and Methods of Risk Evaluation, Vienna, May 14-18, 1962. 27p.

The experimental nuclear power plant at Lucens will be constructed in a cavern. The reactor will be a carbon dioxide-cooled, heavy water-moderated, pressure tube type with a thermal output of 30 Mw. The study shows that the confinement enclosure envisaged for the underground plant and the possibility of accelerating the lowering of residual pressure in the reactor cavern constitute an efficient and economic solution for limiting the effects of the hypothetical maximal accident. The homogeneous rock with its high porosity is particularly suited for the confinement. Nevertheless, the installation of compressor equipment will permit the strong reduction of escaped gases in case of an accident. The study also shows that a high degree of tightness may be obtained in constructing the reactor plant. Mathematical analysis is given for the diffusion of fission gases in rocks, leakages from the confinement enclosure, and lasting contamination of rock. (N.W.R.)

30106 (JPRS-14976) THE ROLE OF PLUTONIUM IN THE DEVELOPMENT OF NUCLEAR POWER ENGINEERING. O. D. Kazachkovskii (Kazachkovskiy) and V. B. Lytkin. Translated from Vestnik Akad. Nauk S.S.S.R., 32: No. 6, 41-9(June 1962). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 26609.

30107 THE VULCAIN PROJECT AND ITS DEVELOPMENT PROCESSES. P. Maldague (Project Vulcain, Belgonucléaire, Brussels). Atomwirtschaft, 7: 317-21(June 1962). (In German)

The general concept of the Vulcain Reactor is based on the principle of variable moderation. Variable moderation can be achieved through two mutually independent factors: a temperature change of the moderator which has a temperature different from that of the coolant and a periodic change in the composition of the moderator. The special concept of the Vulcain Reactor rests on the use of a mixture of light and heavy water under high pressure for both the moderator and the coolant. The coolant passes through the upper part of the reactor core in the pressure vessel and then gives up its heat in a steam generator. The moderator also flows through the core in a closed circuit, its temperature being adjusted in a special heat exchanger according to the desired reactor output. The fuel elements consist of slightly enriched uranium oxide in the form of tablets clad with Zircaloy or stainless steel. This reactor is being studied for utilization in ship propulsion. (auth)

30108 SAFETY REQUIREMENTS ON THE SITE SELECTION FOR ATOMIC POWER PLANTS. F. Schweiger, J. Wohler, and W. Schreckenberg. Atomwirtschaft, 7: 338-40(July 1962). (In German)

The possible danger to the surroundings from a reactor accident depends not only on its thermal loading, but predominantly on the reactor type and the construction details. The recommendations of the USAEC are briefly reviewed to show how they have been misunderstood to imply that nuclear power stations of the same capacity offer the same danger to their environment. The uncertainties of such a conception are illustrated by a discussion of the site selection and safety factors of the AVR Reactor. (J.S.R.)

30109 POWER REACTORS—STATE OF DEVELOPMENT AND PLANNING. II. Peter Engelmann. Atomwirtschaft, 7: 365-8(July 1962). (In German)

In the concluding section of the review on the development of power reactors in the world, the power reactors being built and constructed in the Soviet Union are first reviewed. Then the significance of this world development for the German Federal Republic is discussed. (J.S.R.)

30110 NUCLEAR ENERGY IN CONTEMPORARY ENERGETICS. Felice Ippolito (Comitato Nazionale Energia Nucleare, Rome). Diritto econ. nucleare, 3: No. 1, 10p. (1961). (RT/EC(62)1). (In Italian)

It is proposed that reductions of conventional power costs to 5.5 mill/kwh does not pose a threat to the competitiveness of nuclear power. It is predicted that the steadily decreasing cost of nuclear power and rising power requirements will combine to make nuclear power competitive. The achievement of reduction of capital cost down to 15 to

40% below that of the Bradwell plant is noted, and some elements contributing to this reduction are discussed, viz. increases in plant dimensions, technological progress, and reduced projection and construction expenses. It is noted that in England nationalization makes possible amortization plans with such rates of interest as to set the annual share of the fixed charge at 7 to 8% of the capital cost, at a charge of 5 mill/kwh. The capital costs for American BWR's ($260/kwe) and OCR's ($220/kwe) are compared. Fuel costs in England reach $40 to $56 per kg of natural U, which, with the credit of $13 to $17 per kg of spent fuel, is equivalent to about 2 mill/kwh. The U.S. fuel cost reductions of 20 to 34% result from decreases in U concentrate prices and from savings realized by gaseous diffusion processes. It is predicted that nuclear power should become competitive with conventional power within 10 years. (auth)

30111 REACTORS FOR THE PRODUCTION OF ELECTRICITY. M. Pascal (Commissariat a l'Energie Atomique, [Paris]) and J. P. Roux. Énergie nucléaire, 4: 182-8(May-June 1962). (In French)

A comparative description of the natural uranium, graphite, carbon dioxide reactors G-1 and G-2 at Marcoule and EDF-1, EDF-2, and EDF-3 at Chinon indicates the evolution of French reactors and their possible future development. After showing the features that characterize these reactors, the tests on scale models and prototypes which led to their development are reviewed. (tr-auth)

30112 OPERATING EXPERIENCE WITH THE DOUNREAY FAST REACTOR. K. Henry and D. C. G. Smith. J. Brit. Nuclear Energy Soc., 1: 186-99(July 1962).

The mechanical, chemical engineering and chemical problems of the Dounreay Fast Reactor have been largely overcome. The heat removal circuits and control rod mechanisms are now functioning as required, and the purity of the coolant has been very much improved. Operation of the reactor in the medium power range (up to 11 Mw) has shown the reactor to be stable and controllable with no special difficulties deriving from its operation as a fast system. Results are given for shielding and kinetic experiments. (auth)

30113 THE DESIGN, CONSTRUCTION AND TESTING OF A PRESTRESSED CONCRETE REACTOR PRESSURE VESSEL MODEL. A. L. L. Baker, M. L. A. Moncrieff, I. W. Hannah, and S. Gill. J. Brit. Nuclear Energy Soc., 1: 200-19(July 1962).

The design, construction, and pressure testing of a one-sixth-scale model prestressed concrete pressure vessel for containing a nuclear reactor are described. Such vessels may ultimately enable the thick-walled steel pressure vessels with independent concrete biological shield, currently used in gas-cooled, graphite-moderated nuclear power stations, to be replaced by a single composite structure. The work demonstrated that such a development is not only feasible, but appears to offer considerable economic advantages, without any diminution of the high safety standards demanded by the industry. (auth)

30114 FIRST STEPS TOWARDS CONVENTIONAL NUCLEAR POWER. J. P. Roux and C. Bienvenu. J. Brit. Nuclear Energy Soc., 1: 235-59(July 1962).

The development of the reactors EDF-1, EDF-2, and EDF-3 is described with comparisons with G-2 and G-3. The operating characteristics of the three reactors are tabulated. The items discussed are site choice and layout, reactor design, optimization, CO_2 circuits, water-steam circuits, heat exchangers, turbines, etc. Construction of EDF-3 started at the end of 1961. (D.L.C.)

30115 THE DRAGON-PROJECT. H. W. Schmidt (Dragon-Project Winfrith, Dorset, Eng.). Kerntechnik, 4: 293-7(July 1962). (In German)

A description is given of the Project and particularly of the Dragon Reactor, which is under construction at Winfrith/Dorset, the research center of the AEA at the English south coast. Besides the plant itself, some typical phenomena and problems of this system are described such as special features of the neutron physics, the behavior of fission products, and the corrosion of graphite. The technical and economical possibilities are discussed briefly. (auth)

30116 OPERATING EXPERIENCE WITH THE DOUNREAY FAST REACTOR-2. J. L. Phillips (United Kingdom Atomic Energy Authority, Dounreay, Scotland). Nuclear Power (England), 7: 50-4(Aug. 1962).

Control and coolant problems, control unit modifications, physics measurements and calculations, stability studies, and the status of the reactor are reviewed through the second core loading. The stability and ease of control of the reactor are found to be satisfactory. (T.F.H.)

30117 RAPID ESTIMATION OF NUCLEAR POWER COSTS. David P. Herron (Advanced Technology Labs., Mountain View, Calif.). Nucleonics, 20: No. 8, 128-30 (Aug. 1962).

The basis is reviewed for calculating the unit power generating costs in mills/kwh from capital, fuel, and operating costs. Graphs are given for making the calculations. As an example of the use of the graphs, the power generating cost for the Bodega Bay nuclear plant is calculated on the basis of the old and new uranium price scales. (D.L.C.)

30118 NUCLEAR ENERGY IN ACTUAL PRACTICE. Felice Ippolito (Comitato Nazionale Energia Nucleare, Rome). Tecnico ital., 27: No. 5, 3-15(June 1962). (RT/EC(62)7). (In Italian)

The role played by nuclear power in the Italian energy budget is illustrated in the light of the latest technical and economic developments and of future electric power requirements. The conclusions arrived at permit an accurate assessment of the importance of the studies and research carried out in Italy and of the remarkable realizations being achieved by Italy in the nuclear sector. (auth)

30119 POWER REACTOR TECHNOLOGY. Technical Progress Review, Vol. 5, No. 3. Walter H. Zinn (General Nuclear Engineering Corp., Dunedin, Fla.). June 1962. 94p. $0.55(GPO)(Domestic), $0.70(GPO)(Foreign).

Reviews of selected recently published reports concerning power reactor research and development, applications, design practice, and operating experience are presented. Included are sections containing related information on reactor fuel cycles and fuel utilization, reactor physics, heat transfer, shielding, reactor materials, reactor components, design practices used at Hallam, organic-cooled reactors, gas-cooled reactors, steam-cooled reactors, reactor experiments, and the variable moderator reactor concept. (J.R.D.)

30120 OPTIMIZATION OF HEAVY WATER POWER REACTORS. J. Gilbert Brewer (E. I. du Pont de Nemours & Co., Inc., Aiken, S. C.), Lawrence Isakoff, James W. Wade, William A. Chittenden, and George F. Hoveke. Preprint Paper No. 44. New York, Engineers Joint Council, 1962. 19p.

A computer code was developed that would rapidly evaluate the design and cost of a D_2O power reactor system as a function of various engineering and economic criteria. A brief description of the code, its versatility, and the mag-

nitude of the job it performs are presented, along with several illustrative examples. (L.T.W.)

30121 ECONOMIC ASPECTS OF SYSTEM EXPANSION WITH NUCLEAR UNITS. C. J. Baldwin (Westinghouse Electric Corp., Pittsburgh), H. G. Houser, J. A. Casazza, and P. A. Salmon. Preprint Paper No. 45. New York, Engineers Joint Council, 1962. 17p.

The results obtained from a simulation study of electric utility system expansion with various amounts of nuclear generation in large units are described. Estimates of capital costs, fuel costs, and operation and maintenance costs are used for closed-cycle water plants from 600 to 1000 Mw. The economic applications of specific plants are studied in terms of present worth of all future revenue requirements. Additional studies investigate the effect of varying nuclear unit availability, fossil-fuel escalation assumptions, and nuclear fuel prices. (auth)

30122 A DIGITAL COMPUTER ANALYSIS OF PRESSURIZED WATER NUCLEAR POWER PLANT START-UP USING NATURAL CIRCULATION. Amir N. Nahavandi and Bertil H. Axelson (Westinghouse Electric Corp., Pittsburgh). Preprint Paper No. 55. New York, Engineers Joint Council, 1962. 33p.

An analysis of the natural circulation in the primary system of a pressurized water nuclear power plant during plant start-up is presented. The solution to the problem is obtained by numerical integration of the governing differential equations, using an IBM-7090 digital computer. Thermodynamic behavior of primary system coolant during plant start-up under natural circulation is investigated. Coolant mass flow rate and thermodynamic properties together with the average fuel temperature are determined as functions of time. Under simplifying assumptions used in this study, the present analysis and digital program can also be applied to the solution of such primary system transient problems as the system response due to power unbalance. This study is also helpful in determining (1) the system behavior during a total loss-of-flow accident; and (2) the performance of the plant with natural circulation. (auth)

30123 NEEDS AND PROBLEMS OF PROVIDING NUCLEAR TRAINING IN ELECTRIC UTILITIES. Warren F. Witzig, John C. Young, and Donald L. Couchman (Nuclear Utility Services, Inc., Washington, D. C.). Preprint Paper No. 59. New York, Engineers Joint Council, 1962. 18p.

The various courses of action in the area of training which are open to a utility company entering the nuclear power field are discussed. The depth of training required is a function of the background of the personnel involved and the degree of participation desired by the utility company in the design, construction, and initial startup of the reactor plant. Significant management functions relating to reactor operation are discussed and their effects on training needed to support long-term operation of the plant are identified. (auth)

30124 NUCLEAR POWER APPLICATION IN THE MARITIME INDUSTRY. R. P. Godwin and J. E. Robb (Bechtel Corp., San Francisco). Preprint Paper No. 68. New York, Engineers Joint Council, 1962. 13p.

A discussion is given of what has been accomplished in the present nuclear merchant ship program and what can be expected in the future. Cost and operational comparisons are made between conventional and nuclear merchant vessels. (L.T.W.)

30125 POWER REACTORS FOR MILITARY APPLICATIONS. W. C. Christensen (U. S. Atomic Energy Commission, Washington, D. C.). Preprint Paper No. 69. New York, Engineers Joint Council, 1962. 17p.

Some of the major problems unique to the development of power reactors for military applications are outlined along with proposed solutions. (L.T.W.)

30126 NUCLEAR POWER PLANT CONSTRUCTION AND OPERATION IN THE ANTARCTIC. Russell J. Bartell (Bureau of Yards and Docks). Preprint Paper No. 70. New York, Engineers Joint Council, 1962. 32p.

Remote plant design considerations are outlined. Then, the design and construction of the PM-3A plant, located at McMurdo Station, Antarctica, are discussed. (L.T.W.)

30127 NUCLEAR POWER PLANTS AND THE ANTARCTIC ENVIRONMENT. Philip W. Brewer (Bureau of Yards and Docks). Preprint Paper No. 76. New York, Engineers Joint Council, 1962. 20p.

Criticality was achieved at the PM-3A nuclear power plant at McMurdo Station, Antarctica, on 3 March 1962. Another nuclear power plant is now under contract for installation at Byrd Station, Antarctica. Because of the prohibition of radioactive waste disposal in the Antarctic and the requirements of the scientific program being conducted in the Antarctic, no significant increases in the radiological background are permitted. A preoperational environmental survey was conducted, and will be continued throughout the operational period to assess the effects of the reactor thereon. All radiological wastes will be packaged in accordance with ICC regulations and will be removed from the Antarctic continent. In addition, the other effects of the Antarctic environment on the application of nuclear power are noted. (auth)

Production Reactors

30128 (HW-71083) FIELD LEAK TESTING OF HAPO REACTOR CONFINEMENT FILTER INSTALLATIONS. E. L. Etheridge (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 19, 1961. Contract [AT(45-1)-1350]. 24p.

A portable air-operated dioctylphthalate aerosol generator and particle detector was used in leak testing the high efficiency air filter banks after initial installation in the confinement facilities of the HAPO reactors. A total of 1024 filters were checked and of these 24 indicated leaks and were replaced. Approximately 20% of the filters required gasket reseating and/or tightening. The testing method, which was adapted from the Naval Research Laboratory, proved to be a practical and reliable method for assuring the integrity of the filter banks after installation. (auth)

30129 (HW-72097) RESULTS OF HEAT TRANSFER EXPERIMENTS FOR COOLING OF PRTR FUEL ELEMENTS BY TRANSVERSE AIR FLOW. E. D. Waters, T. W. Ambrose, and M. E. Shockley (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 28, 1961. Contract AT(45-1)-1350. 26p.

Results of heat transfer experiments are presented in which prototype PRTR fuel elements were cooled by the transverse flow of air. The equipment and conditions were chosen to simulate the conditions which will exist in the fuel examination cell of the Plutonium Recycle Test Reactor. Fuel surface temperatures and heat transfer coefficients are evaluated as a function of location on the fuel, the heat flux, and the air flow rate. Pressure drop data are also presented. (auth)

30130 (HW-73292) PRTR COOLING FOLLOWING LOSS OF FORCED CIRCULATION OF PRIMARY COOLANT.

J. K. Anderson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 6, 1962. Contract AT(45-1)-1350. 12p.

A discussion of sequences of events following loss of forced convection circulation in the PRTR cooling system is presented. Recommendations for actions to prevent fuel element over-heating are included. (J.R.D.)

Research Reactors

30131 (ANL-6458) KINETICS OF TREAT USED AS A TEST REACTOR. C. E. Dickerman, R. D. Johnson (Argonne National Lab., Ill.) and J. Gasidlo (Argonne National Lab., Idaho Falls, Idaho). May 1962. Contract W-31-109-eng-38. 60p.

An analysis is presented concerning the reactor kinetics of TREAT used as a pulsed, engineering test reactor for fast reactor fuel element studies. A description of the reactor performance is given for a wide range of conditions associated with its use as a test reactor. Supplemental information on meltdown experimentation is included. (J.R.D.)

30132 (HW-61900BA) PLUTONIUM RECYCLE TEST REACTOR CRITICAL TEST RESULTS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1961. Contract AT(45-1)-1350. 40p.

Results of the PRTR critical tests, an extensive testing program which was part of the startup of the Plutonium Recycle Test Reactor, are presented. Included are data on fuel loading, moderator level coefficients, shim rod calibrations, temperature coefficients, flux distributions, boron poison, and substitution tests. Limited analyses of the data show the reactor to have negative void and temperature coefficients, and kinetics parameters which exhibit satisfactory control characteristics. (auth)

30133 (IA-680) ISRAEL RESEARCH REACTOR IRR-1. PART I. GENERAL DESCRIPTION. R. S. Kahan, comp. (Israel. Atomic Energy Commission, Tel Aviv). 1961. 68p.

A description of the design of the more important parts of the Israel Research Reactor IRR-I facility is presented. Design data for the reactor are presented, as are sample calculations, based on a 1 Mw operation reference core, for the operation of the control system and of the irradiation facilities. The equipment and instrumentation provided to assure adequate control during operation and to avoid contamination in case of an accident are described. (auth)

30134 (IA-686) ISRAEL RESEARCH REACTOR IRR-1. PART II. STARTUP TESTS. Z. Pelled and R. S. Kahan (Israel. Atomic Energy Commission, Tel Aviv). 1961. 87p.

Tests made during the pre-critical, approach to critical, and low power experiments, and during initial operation at 1 Mw of the Israel Research Reactor-I are described. Critical experiments, control rod calibrations, neutron flux measurements and the reactivity effects of temperature and experimental facilities are included. Core loadings with available excess reactivities (%ΔK) of 0.37 to 4.32%, and 0.24 to 2.03%, respectively, were tested in the pool and stall positions. The regulating rod worths obtained for different core loadings and with various control rod settings ranged from 0.285 to 0.367%ΔK. The shim-rod worths for core loading SK 1 were in the 2.3 to 3.7% range. The shim-rod bank of 5 shim-rods, withdrawn to the 60% setting was worth 11.3% excess reactivity, indicating that the reactor had sufficient control capacity. The reactivity effect of the facilities around the stall position was about 1.37%ΔK for core loading SK 1. The total worth of water filling all the beam tubes was 1.24%, and the effect of material in the pneumatic tubes was negligible. The temperature coefficient of reactivity was -3.6×10^{-4} per degree at 30.3°C. (auth)

30135 (JAERI-1018) LEAK TEST OF THE JRR-2 HOUSING BUILDING. (Japan Atomic Energy Research Inst., Tokyo). Apr. 1962. 16p. (In Japanese)

Results of leak tests on the reactor building are discussed. This building is covered with steel sheets and is designed so that an air-lock room serves as the container doorway. The pressure decrease and flow test methods were used. (J.R.D.)

30136 (JAERI-1026) SAFETY ANALYSIS OF THERMAL PROBLEMS FOR PLATE-TYPE CORE FUEL. Hiroji Shimamune and Tatsuo Oku (Japan Atomic Energy Research Inst., Tokyo). July 1962. 37p. In Japanese.

Examination of the JRR-2 first loading fuel assemblies revealed metallic U and UC as inclusions which have high specific heat generation in the U-Al alloy. An analysis of the simple model with adequate shape and size of the inclusions and the conservative assumptions was performed to find out the limit of output power level. Results indicate that metallic U inclusion permits 2000 kw level operation if the inclusions are of the shape of a solid cylinder, 100 mils in dia. 20 mils thick. Also the highest temperature of the inclusions does not exceed the allowable temperature of the fuel without inclusions. It was also shown that the analysis was rather conservative and fairly reliable compared with the experiment of simulated fuel plate with electric heater. (auth)

30137 (JAERI-1031) CRITICALITY CALCULATION OF THE JRR-3. Takumi Asaoka (Japan Atomic Energy Research Inst., Tokyo). Jan. 1962. 50p. (In Japanese)

A criticality analysis which is performed by using a new 3-group method is described. Comparison of the calculated results with earlier ones reveals that the values of the effective multiplication factor for the reactor coincide within less than 1 ~ 2%. Moreover, a comparison of the calculated effective multiplication factor value with the experimental one for the FR-2 shows that the effective multiplication factor for the JRR-3 can be estimated within an error of less than 1 ~ 2%. According to these considerations, allowing for an error of ±1.5% in the value of the effective multiplication factor calculated, it is determined that the JRR-3 will reach criticality when the heavy-water level is raised by $(2.05^{+0.35}_{-0.1})$m from the upper surface of the grid plate. In other words, the critical geometric buckling is expected to be $(4.8 \pm 0.5)m^{-2}$ and the critical mass of U^{235} in the core to be $(21.5^{+1}_{-1.5})$kg. (auth)

30138 (JAERI-6009) [REPORT ON THE PROCEEDING OF CONSTRUCTION OF JRR-2]. (Japan Atomic Energy Research Inst., Tokyo). 1962. 52p. (In Japanese)

An account of the JRR-2 reactor construction is given. The JRR-2 is a research reactor moderated by heavy water with MTR-type enriched U fuel elements. The reactor was designed for a thermal output of 10 Mw and a neutron flux of 10^{14} n/cm^2 sec. (J.R.D.)

30139 (JEN-103-DF/I-31) MEDIDA DE FLUJOS EN LOS CANALES DE RADIACION DEL REACTOR JEN-1. (Flux Measurement in the Beam Holes of JEN-1 Reactor). M. Enriquez de Salamanca (Spain. Junta de Energia Nuclear, Madrid). 1962. 25p.

Axial flux distributions in several beam-ports were determined by means of gold and manganese foils. Self-shielding and self-absorption corrections were applied.

Thermal and epithermal fluxes were distinguished by means of the cadmium ratio. (auth)

30140 (ORNL-3248) HEALTH PHYSICS RESEARCH REACTOR HAZARDS SUMMARY. M. I. Lundin (Oak Ridge National Lab., Tenn.). Sept. 10, 1962. Contract W-7405-eng-26. 96p.

The Health Physics Research Reactor is an essentially unmoderated, unreflected, uranium-molybdenum alloy assembly that is capable of producing self-limiting prompt-critical bursts with yields of the order of 10^{17} fissions. The design and performance characteristics, although similar to Godiva assemblies, are improved by the use of the alloyed fuel material for the core assembly. The reactor will be utilized in the Dosimetry Applications Research Facility (DOSAR) constructed at the Oak Ridge National Laboratory for the furtherance of the health physics and biomedical research programs. The design of the reactor and its controls and the siting of the facility are such that normal operation of the reactor will not involve radiation levels that are hazardous to either operating personnel or to the general public. The facility will safely handle the postulated maximum credible accident of 10^{19} fissions. (auth)

30141 (ORNL-TM-273) VAPOR CONTAINMENT IN THE OAK RIDGE RESEARCH REACTOR. F. T. Binford (Oak Ridge National Lab., Tenn.). Aug. 23, 1962. Contract W-7405-eng-26. 30p.

Containment of the ORR is attained by means of a ventilation system which is capable of exhausting air from the building at a rate sufficient to ensure that all leakage of air at ground level is into the building. The exhaust air is treated by scrubbing and filtration and is discharged from a large stack at a height and velocity sufficient to guarantee that meteorological dispersion will reduce the resulting concentration of radioactive material to an acceptable level. Factors involved in selection of this type of controlled containment are discussed. Original design and modifications are described. Performance is also discussed. (M.C.G.)

30142 (ORNL-TM-274) THE DETECTION OF BOILING IN A WATER-COOLED NUCLEAR REACTOR. A. L. Colomb and F. T. Binford (Oak Ridge National Lab., Tenn.). Aug. 17, 1962. Contract W-7405-eng-26. 21p.

Measurements made at ORNL to study the feasibility of boiling detection in a water-cooled nuclear reactor are described. The methods selected for the detection of boiling include measurement of the acoustical noise produced by the generation of bubbles and measurement of changes in the reactor-power spectral density produced by bubbles. Preliminary results indicating that both methods could detect boiling are shown. (auth)

30143 (ORNL-TM-275) PROBLEMS ENCOUNTERED DURING FOUR YEARS OF ORR OPERATION. W. H. Tabor and R. A. Costner, Jr. (Oak Ridge National Lab., Tenn.). Aug. 23, 1962. Contract W-7405-eng-26. 87p.

The over-all design and operation of ORR is reviewed in the light of four years of operating experience. Items discussed consist of the reactor components and instrumentation, reactor and pool cooling systems (including system cleanup), the emergency systems for electric power and reactor cooling, the waste-disposal systems (liquid, gaseous, and solid), and the building, itself. The ORR was the first of a class of reactors which combined the features of both the pool-reactor and tank-reactor types. Four years of operation indicated areas where problems of various degrees have developed. These problems are discussed. (auth)

30144 (ORNL-TM-276) ADMINISTRATION OF ORNL RESEARCH REACTORS. W. R. Casto (Oak Ridge National Lab., Tenn.). Aug. 20, 1962. Contract W-7405-eng-26. 54p.

Organization of the ORNL Operations division for administration of the Oak Ridge Research Reactor, the Low Intensity Testing Reactor, and the Oak Ridge Graphite Reactor is described. (J.R.D.)

30145 (ORNL-TM-279) THE OAK RIDGE RESEARCH REACTOR (ORR), THE LOW-INTENSITY TESTING REACTOR (LITR), AND THE OAK RIDGE GRAPHITE REACTOR (OGR) AS EXPERIMENT FACILITIES. Kenneth D. George (Oak Ridge National Lab., Tenn.). Aug. 28, 1962. Contract W-7405-eng-26. 117p.

Characteristics of the ORR, LITR, and OGR that experimenters have found to be important are listed. The results of a survey conducted among experimenters on the utility of the reactors for various types of experiments are discussed, and some changes which might be made to improve the utilization are listed. A brief outline, with references, of most of the experiments currently being performed is included. (auth)

30146 (ORNL-TM-283) REACTOR CONTROLS RELIABILITY AND MAINTENANCE AT THE ORR. K. W. West (Oak Ridge National Lab., Tenn.). Aug. 28, 1962. Contract W-7405-eng-26. 37p.

Early evaluation and study of the various criteria for the ORR clearly established the requirements for the fundamental safety and control instrumentation, and the instrumentation was well integrated into the design and construction of the plant. However, it was not designed for the optimum of maintenance convenience and minimum reactor down time in the event of instrument failure. The revisions and additions that have been made in the physical plant and maintenance which have resulted in a definite reduction of reactor down time resulting from instrument failure in the reactor and in the experiments are described. (auth)

30147 (TID-15978) ORGANIC MODERATOR-COOLANT IN-PILE IRRADIATION LOOP FOR THE M.I.T. NUCLEAR REACTOR. First Annual Report, October 1, 1958 to October 1, 1959. E. A. Mason and D. T. Morgan (Massachusetts Inst. of Tech., Cambridge). Jan. 1, 1960. For Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif. Contract AT-11-1-GEN-8, Subcontract N9-S-514. 81p. (MITNE-4)

A detailed description of the in-pile section, out-of-pile section, and the instrumentation of the Organic Moderator-Coolant In-Pile Irradiation Loop for the MIT Nuclear Reactor is given. The methods to be used in measuring the dose rate in the organic materials are described. These include a calorimetric measurement of the fast neutron and gamma dose rate before insertion of the in-pile section into the reactor and monitoring of the dose rate throughout any run after insertion. The physical and chemical measurements to be made on the irradiated organic material to determine the changes induced are briefly summarized. An evaluation of the development effort to date is included. (auth)

30148 CONTROL OF RADIATION QUALITY AND FIELD SIZE AT THE TREATMENT PORT OF THE MEDICAL RESEARCH REACTOR. J. S. Robertson, E. E. Stickley, and R. W. Powell (Brookhaven National Lab., Upton, N. Y.). J. Nuclear Med., 3: 360-6(Sept. 1962). (BNL-4837)

The design of the Brookhaven Medical Research Reactor (MRR) is described and illustrated. Problems of controlling the radiation quality and field size at the treatment port are discussed. The objectives are achieved by limit-

ing the slow neutrons to the desired area and eliminating the fast neutrons and γ rays. Procedures used are described in detail. (C.H.)

30149 RESEARCH AND TESTING REACTORS THE WORLD AROUND. Nucleonics, 20: No. 8, 116-21(Aug. 1962).

A table is presented on the testing, research, and training reactors of the world. Power and experimental reactors and subcritical assemblies are excluded. The items included in the table are thermal power, fuel element characteristics, coolant/moderator/reflector used, maximum flux, designer/builder, owner/operator, and remarks on reactor type and use. Notes are also given. (D.L.C.)

SPACE APPLICATIONS AND TECHNOLOGY

30150 (NAA-SR-7085) ELECTRIC PROPULSION APPLICATIONS FOR SNAP SYSTEMS. C. J. Morse (Atomics International. Div. of North American Aviation Inc., Canoga Park, Calif.). Apr. 6, 1962. Contract AT(11-1)-GEN-8. 40p.

The application of SNAP systems to electric propulsion was investigated. A review is given of the basic analysis involved in establishing optimum power levels and payload capabilities for electric spacecraft, and several typical missions are analyzed to determine the usefulness of the SNAP systems which are under development or systems which are based on the current SNAP technology. In general, it is found that SNAP power units in the range of 60 to 180 kw offer significant mission capability when used in conjunction with initial spacecraft weights of about 10,000 lb in a low-level orbit. (auth)

30151 (TID-3561(Rev. 2)) DIRECT ENERGY CONVERSION AND SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP). A Literature Search. Sidney F. Lanier and Henry D. Raleigh, comps. (Division of Technical Information Extension, AEC). Aug. 1962. 56p.

References (422) on the SNAP program and related topics are given to journals, reports, and U.S. and foreign patents published from 1950 to February 1962. (P.C.H.)

30152 (FTD-TT-62-409) ELECTRICAL PROPULSION SYSTEMS FOR SPACE ROCKETS. J. Pokorny. Translated from Kridla Vlasti, No. 5, 14-16(1961). 7p.

Developments on electrothermal, electrostatic, and electrodynamic propulsion systems are described. Sources of electric energy are listed. Systems for flights beyond the terrestrial atmosphere are discussed. (M.C.G.)

WASTE DISPOSAL AND PROCESSING

Refer also to abstracts 29038, 29226, 29239, and 29247.

30153 (EURAEC-184) INVESTIGATIONS ON THE MOVEMENT OF RADIOACTIVE SUBSTANCES IN THE GROUND. Special Report No. 1. PART I. GEOHYDROLOGY AND GENERAL CONSIDERATIONS. E. S. Simpson. PART II. THE COPPER-ROD METHOD FOR MEASURING GROUND-WATER FLOW. J. Souffriau, E. Simpson, L. Baetslé, and P. Dejonghe. PART III. PRACTICAL ASPECTS OF THE PROGRAM AND PHYSICOCHEMICAL CONSIDERATIONS. L. Baetslé and P. Dejonghe (Brussels. Centre d'Étude de l'Énergie Nucléaire). [Sept. 1961]. Work performed under United States–Euratom Joint Research and Development Program. 40p. (BCH/MOO2)

A research program concerned with the treatment and disposal of radioactive wastes is discussed. The program is devoted to development of methods for quantitative evaluation of terrestrial sites for ultimate disposal. Sites chosen for use as outdoor laboratories in which methods may be field tested include a dominantly sandy terrain and a dominantly clayey area. Other information concerning the movement of radioactive substances in the ground is presented in discussions of the Cu-rod groundwater flow measuring method and physicochemical aspects of the disposal sites. (J.R.D.)

30154 (HW-73482) CRIB DISPOSAL OF THE NPR DECONTAMINATION WASTES. D. W. Bensen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 10, 1962. Contract AT(45-1)-1350. 14p.

Decontamination of the NPR will generate large volumes of radioactive waste cleaning solutions. A proprietary phosphoric acid cleaner (Hanford designated Phos-1) is specified for a once-through front and rear face decontamination. A recirculation (multistep) process is specified for decontamination of the full reactor or single loop cells. The latter process involves the consecutive recirculation and rinsing of peroxide carbonate, alkaline permanganate, and a proprietary sodium bisulfate cleaning solution. Combining the multistep cleaning solutions and adding of an iron salt causes a precipitate which scavenges most of the radionuclides from solution. The addition of iron and calcium salts and sufficient caustic to neutralize fully ($\geq$ pH 12) the Phos-1 waste also scavenges most radionuclides from this solution. Research was undertaken to determine, on the basis of laboratory permeability and filtration experiments, the feasibility of disposing of the scavenged NPR decontamination wastes to a crib. Soil permeability of NPR decontamination wastes was found to be 43 to 65% that of water. Based on operating experiences with 200-Area cribs, the rate of sludge-free waste percolation from a crib is estimated to be 2 to 4 gal/ft^2/day. More than six hours were necessary to settle completely the slowest settling Phos-1 waste solids. The expected annual volume of waste sludge was estimated to be about 24,000 ft^3 in 4.5×10^6 gallons of waste. (auth)

30155 (HW-74375) RESEARCH AND DEVELOPMENT ACTIVITIES— FIXATION OF RADIOACTIVE RESIDUES, QUARTERLY PROGRESS REPORT, APRIL–JUNE 1962. E. R. Irish, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1962. Contract AT(45-1)-1350. 45p.

Research and development studies continued on the radiant-heat spray calciner mock-up system. After A-Cell in the High-Level Radiochemistry Facility was decontaminated and cleared, installation of the spray calciner system was started. Sorption studies using natural minerals, synthetic inorganic zeolites, and resins were continued to explore and develop the place of sorption processes in the over-all waste fixation picture. In addition, studies are reported on the recovery of specific nuclides (e.g., cesium) as a step in high-level waste treatment and fixation. (auth)

30156 (HW-74536) FISSION PRODUCT TRITIUM IN SEPARATIONS WASTES AND IN THE GROUND WATER. W. A. Haney, D. J. Brown, and A. E. Reisenauer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1962. Contract AT(45-1)-1350. 14p.

A program to determine the relative distribution of tritium in cribbed waste streams and ground water is described. Analyses of composited waste samples from the Purex and Redox separations plants indicate that about 47 to 64% of the theoretical quantity of fission product tritium entering the plants is discharged to ground in process waste streams. Although a precise material balance cannot be calculated at present because of insufficient data, most of the remaining 36 to 53% of charged fission product tritium is believed to be in a gas phase, which is released to the atmosphere, and in high level liquid wastes, which are stored in underground tanks. Ground water contamination patterns based on tritium concentrations are similar to those based on gross beta emitter and nitrate ion concentrations. The comparatively rapid movement of tritium in the ground water has assisted in defining the preferential paths which other radionuclides may later follow. Tritium concentrations exceeding the recommended maximum concentrations in drinking water for continuous non-occupational exposure, 1×10^{-6} μc/cc, were observed in monitoring wells located up to six miles southeast of the 200-East Area. (auth)

30157 (TID-3555(Suppl.1)) RADIOACTIVE WASTE PROCESSING AND DISPOSAL. A Literature Search. Theodore F. Davis, comp. (Division of Technical Information, AEC). Aug. 1962. 156p.

References (874) are given to reports, bibliographies, books, journals, and patents published from 1954 through April 1962. Author and report number indexes are included. (P.C.H.)

30158 DRUM TRANSPORT EQUIPMENT IN DEACTIVATION INSTALLATIONS. H. Witte (Donges Stahlbau GmbH, Darmstadt, Ger.). Kerntechnik, 4: 288-90(July 1962). (In German)

Equipment is discussed which was developed for the bottling and the transport of radioactive waste products. In this connection, special emphasis was placed on a description of the single elements in order to create foundations for the planning of new installations. (auth)

30159 MANAGEMENT OF HIGH-LEVEL WASTES— CURRENT PRACTICE. Bruce F. Campbell, Edward Doud, and Roy E. Tomlinson (General Electric Co., Richland, Wash.). Preprint Paper No. 53. New York, Engineers Joint Council, 1962. 28p. (HW-SA-2478)

The pertinent features of current waste storage practices are reviewed, and this information is presented in a form useful to management and engineering personnel. (L.T.W.)

30160 MANAGEMENT OF HIGH-LEVEL WASTE—FUTURE POSSIBILITIES. James I. Stevens and J. A. McBride (Phillips Petroleum Co., Idaho Falls, Idaho). Preprint Paper No. 78. New York, Engineers Joint Council, 1962. 27p.

The land, oceans, and outer space zones have been examined for their role in the future management of high-level radioactive wastes. It is concluded that disposal into land masses is the most probable method in the immediate future and that containment of radioactive wastes as stable, solid media is the most probable form. Disposal methods capable of giving the greatest possible assurance of long-term biological safety for the wastes from power reactor fuel processing should be readily achieved at costs not exceeding two per cent of 8 mills/kwh$_e$. (auth)

CORPORATE AUTHOR INDEX

This index contains entries for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Æ	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

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5287	16-28875	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5290	16-29389	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5291	16-28876	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
5293	16-29491	$1.60(fs), $0.80(mf) JCL
5298	16-29390	Dep.(mc); $2.60(fs), $0.92(mf) JCL
5303	16-29344	Dep.(mc); $2.60(fs), $0.83(mf) JCL
5310	16-29089	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5314	16-29120	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5315	16-29391	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5323	16-29392	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
5324	16-29393	Dep.(mc); $1.60(fs), $0.80(mf) JCL
5325	16-29443	Dep.(mc); $1.10(fs), $0.80(mf) JCL
5330	16-29090	Dep.(mc); $2.60(fs), $0.98(mf) JCL
AECL–	**(Canadian)**	
1549	16-29506	Can. J. Phys., 40: 954-63(1962)
1553	16-29804	Can. J. Phys. 40: 1044-6(1962)
1581	16-28931	Dep.; $0.50(AECL)
1582	16-28932	Dep.; $0.20(AECL)
AEDC-TDR–	**(Non-AEC)**	
62-161	16-29096	
AEET-HP–	**(Indian)**	
3(Rev.)	16-29994	Dep.(mc)
AEET-RMS–	**(Indian)**	
7	16-29207	Dep.(mc)
AERE-R–	**(British)**	
3843	16-29458	Phil. Mag. (8), 7: 803-25(1962)
3945	16-28863	Dep.; $0.42(BIS)
3990	16-29097	Dep.; $0.63(BIS); 4s.6d(HMSO)
4131	16-29746	Dep.
AERE-Trans–	**(British)**	
896	16-29667	Dep.
897	16-29792	Part I also available as JPRS-9691
AERE-X–	**(British)**	
R-376	16-29364	Dep.(mc)
AFOSR–	**(Misc.)**	
971*	16-29747	
2715*	16-29469	OTS
2759*	16-29470	
3003*	16-29634	See CRSR-117
3024*	16-29599	
AFOSR-TN–	**(Misc.)**	
3065*	16-29748	
3066*	16-29749	
AFSWC-TDR–	**(Non-AEC)**	
62-29	16-29437	See GA-2984
AGC–	**(Misc.)**	
0584-04-3	16-29336	
AGN-TM–		
386	16-29995	Dep.(mc); $5.60(fs), $1.73(mf) OTS
ANL–		
6278	16-29996	Dep.; $0.50(OTS)
6423	16-29997	Dep.; $0.50(OTS)
6428	16-29435	Dep.; $0.50(OTS)
6458	16-30131	Dep.; $1.50(OTS)
6475	16-28913	Dep.; $0.50(OTS)
6543	16-28641	Dep.; $3.00(OTS)
6559	16-29629	Dep.; $0.50(OTS)
6570	16-29630	Dep.; $0.50(OTS)
6574	16-29471	Dep.; $4.60(fs), $1.43(mf) OTS
6576	16-29303	Dep.; $0.50(OTS)
6581	16-29998	Dep.; $2.50(OTS)
6584	16-29208	Dep.; $0.50(OTS)
6589	16-29750	Dep.; $2.50(OTS)
ANL-FGF–		
328	16-29165	Rev. Sci. Instr., 33: 844-6(1962)
APAE–	**(Misc.)**	
119	16-30050	Dep.(mc); $10.50(fs), $4.37(mf) OTS
APAE-Memo–	**(Misc.)**	
311(Rev.1)	16-29999	Dep.(mc); $9.60(fs), $3.77(mf) OTS
317	16-30051	Dep.(mc); $8.60(fs), $2.96(mf) OTS
318	16-30000	Dep.(mc); $5.60(fs), $1.79(mf) OTS
319	16-30052	$3.60(fs), $1.40(mf) OTS
321	16-30053	Dep.(mc); $3.60(fs), $1.22(mf) OTS
322	16-30001	Dep.(mc); $5.60(fs), $1.76(mf) OTS
APEX–		
616	16-30002	Dep.(mc); $3.60(fs), $1.22(mf) OTS
906	16-30003	Dep.; $3.00(OTS)
ARF–	**(Misc.)**	
1213-2*	16-29311	
2198-26	16-29337	Dep.(mc); $2.60(fs), $0.86(mf) OTS
2231-5*	16-29348	
4267-1	16-30004	Dep.(mc); $2.60(fs), $0.98(mf) OTS
8262-1	16-30005	Dep.(mc); $4.60(fs), $1.46(mf) OTS
ARL–	**(Non-AEC)**	
62-374	16-29898	$1.75(OTS)
AROD–	**(Misc.)**	
1540.6*	16-29084	
ASD-TR–	**(Non-AEC)**	
7-793(IV)	16-29349	
60-132(Pt.II)	16-29376	See NMI-9237
61-706(Vol.I)	16-29365	OTS
61-706(Vol.II)	16-29350	OTS
AWRE-NR–	**(British)**	
P-3/62	16-29098	Dep.(mc)
AWRE-O–	**(British)**	
42/62	16-29366	Dep.(mc)
BAW–	**(Misc.)**	
1250	16-30006	Dep.; $2.00(OTS)
BCH–	**(Belgian)**	

Report No.	Abstract No.	Availability
M002	16-30153	See EURAEC-184
BLG–	**(Belgian)**	
73	16-28713	J. belge radiol. 43: 393-412(1960)
BMI–	**(Misc.)**	
1581(Del.)	16-28642	Dep.; $2.00(OTS)
1582	16-30054	Dep.; $1.25(OTS)
1591	16-28914	Dep.; $0.50(OTS)
BMI-X–		
199	16-29278	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10009	16-29279	Dep.(mc); $3.60(fs), $1.22(mf) OTS
10011	16-29367	Dep.(mc); $2.60(fs), $1.07(mf) OTS
BNL–		
735	16-29632	Dep.; $2.25(OTS)
749	16-29032	Dep.; $0.75(OTS)
4837	16-30148	J. Nuclear Med., 3: 360-6(1962)
5013	16-29751	Dep.(mc); $11.50(fs), $5.00(mf) OTS
5039	16-28740	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5089	16-28741	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5113	16-29368	Dep.(mc); $2.60(fs), $0.86(mf) OTS
5216	16-28697	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5340	16-28742	Dep.(mc); $2.60(fs), $0.92(mf) OTS
5552	16-28831	p.141-7 of "IV. International Congress of Neuropathology. Vom 4.-8, September 1961. München. Proceedings in Drei Bänden, Thema I/Vol. I." Stuttgart, Georg Thieme Verlag 1962
5859	16-28721	Proc. Soc. Exptl. Biol. Med., 110: 526-8 (1962)
5922	16-29831	Phys. Rev., 127: 867-79(1962)
5979	16-29522	J. Chem. Phys., 37: 234-8(1962)
6003	16-29575	Phys. Rev., 127: 1220-3(1962)
6034	16-29842	Phys. Rev., 127: 950-4(1962)
6038	16-29559	Phys. Rev. 127: 812-16(1962)
6058	16-29567	Phys. Rev., 127: 1124-9(1962)
6074	16-29001	J. Am. Chem. Soc., 84: 3202-4(1962)
BRL–	**(Misc.)**	
1161	16-29472	
CARDE-TM–	**(Canadian)**	
280/59	16-29351	
CEA–	**(French)**	
1500	16-29875	Dep.(mc)
1965	16-28886	Centre belge etude et document. eaux, Bull. trimestr. CEBEDEAU, 4: No. 50, 269-71 (1960)
2092	16-29633	Dep.(mc)
CEND–	**(Misc.)**	
108	16-30007	Dep.(mc); $4.60(fs), $1.46(mf) OTS
135(Vol.IV, Suppl.)	16-30055	Dep.(mc); $6.60(fs), $2.09(mf) OTS
135(Vol.VI)	16-30056	Dep.(mc); $9.60(fs), $3.53(mf) OTS
CEX–		
60.3	16-29099	Dep.; $1.50(OTS)
CLM-R–	**(British)**	
20	16-29899	$0.25(BIS)
CNEN–	**(Italian)**	
124	16-28762	Atti assoc. genet. ital., 6: 353-64(1961)
CRSR–	**(Non-AEC)**	
116	16-29900	
117	16-29634	
CU–	**(Misc.)**	
207	16-29642	See NEVIS-100
213	16-29107	See NEVIS-106
CYNA–	**(Misc.)**	
94	16-30057	Dep.(mc); $9.10(fs), $3.44(mf) OTS
106	16-30058	Dep.(mc); $3.60(fs), $1.16(mf) OTS
115	16-30059	Dep.(mc); $9.60(fs), $3.65(mf) OTS
116	16-30060	Dep.(mc); $10.10(fs), $3.83(mf) OTS
119	16-30061	Dep.(mc); $11.00(fs), $4.67(mf) OTS
D–	**(Misc.)**	
I-82-0174*	16-29901	
I-82-0175*	16-29610	
I-82-0183*	16-29902	

Report No.	Abstract No.	Availability
DASA–	**(Misc.)**	
1291	16-29473	
DCAS-TDR–		
62-112	16-29903	
DEG-Inf. Ser.–	**(British)**	
259	16-30030	Dep.
DLCS–		
5000662	16-30062	Dep.(mc); $3.60(fs), $1.37(mf) OTS
5000762	16-30063	Dep.(mc); $4.60(fs), $1.64(mf) OTS
DMIC–	**(Non-AEC)**	
171	16-29312	
DOFL-TR–	**(Non-AEC)**	
975(Suppl.1)	16-29436	
DP–		
723	16-29313	Dep.; $0.50(OTS)
745	16-30064	Dep.; $0.75(OTS)
755	16-30065	Dep.; $1.00(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
DXRL–	**(New Zealand)**	
F4	16-29181	Dep.(mc)
EFINS–	**(Misc.)**	
62-9	16-29635	Dep.(mc); $11.00(fs), $4.52(mf) OTS
62-26	16-29752	Dep.(mc); $4.60(fs), $1.49(mf) OTS
EOS–	**(Non-AEC)**	
2080-IR-1	16-29478	See NP-11930
3000-Q-1	16-29479	See NP-11935
ER–	**(Misc.)**	
532(Vol.I)*	16-29365	See ASD-TR-61-706(Vol.I)
532(Vol.II)*	16-29350	See ASD-TR-61-706(Vol.II)
EURAEC–		
184	16-30153	Dep.(mc); $3.60(fs), $1.40(mf) OTS
228	16-29345	Dep.(mc); $8.10(fs), $2.72(mf) OTS
231	16-30008	Dep.(mc); $1.60(fs), $0.80(mf) OTS
238	16-30009	Dep.(mc); $3.60(fs), $1.13(mf) OTS
244	16-29358	Dep.(mc); $4.60(fs), $1.49(mf) OTS
251	16-29359	Dep.(mc); $6.60(fs), $2.21(mf) OTS
269	16-28864	Dep.(mc); $3.60(fs), $1.31(mf) OTS
272	16-29360	Dep.(mc); $1.60(fs), $0.80(mf) OTS
273	16-29361	Dep.(mc); $12.00(fs), $5.09(mf) OTS
304	16-29352	Dep.(mc); $3.60(fs), $1.19(mf) OTS
FTD-TT–	**(Non-AEC)**	
61-114	16-28933	OTS
62-336	16-29911	OTS
62-368	16-29121	OTS
62-380	16-29091	OTS
62-409	16-30152	OTS
62-668	16-29251	OTS
62-714	16-29092	OTS
62-832	16-29965	OTS
62-846	16-29668	OTS
62-897	16-29885	OTS
62-935	16-29886	OTS
62-953	16-29793	OTS
62-982	16-28985	OTS
62-1036	16-29887	OTS
FZK–	**(Non-AEC)**	
9-178	16-29612	See NARF-62-11T
GA–	**(Misc.)**	
1934	16-29369	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1972	16-30010	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2307	16-30066	Dep.(mc); $7.60(fs), $2.42(mf) OTS
2984*	16-29437	
3337*	16-28915	
GEAP–	**(Misc.)**	
3216	16-29370	Dep.(mc); $3.60(fs), $1.22(mf) OTS
3462	16-29338	Dep.(mc); $6.60(fs), $2.09(mf) OTS
3884	16-30067	Dep.(mc); $5.60(fs), $1.94(mf) OTS
4025	16-29339	Dep.; $1.00(OTS)
GEMP–		
13A	16-29314	Dep.; $1.50(OTS)

Report No.	Abstract No.	Availability
14A	16-29438	Dep.; $0.50(OTS)
73	16-30011	Dep.; $2.00(OTS)
130	16-30068	Dep.(mc); $9.60(fs), $3.68(mf) OTS
GNEC–		
211	16-30069	Dep.(mc); $7.60(fs), $2.33(mf) OTS
241	16-30070	Dep.(mc); $9.60(fs), $3.71(mf) OTS
HASL–		
125	16-29631	Dep.(mc); $3.60(fs), $1.34(mf) OTS
129	16-29100	Dep.(mc); $1.60(fs), $0.80(mf) OTS
130	16-29611	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HPR–	(Norwegian)	
19	16-30071	Dep.(mc)
24	16-30072	Dep.(mc)
HW–		
61900BA	16-30132	Dep.; $2.50(OTS)
67102	16-30073	$1.10(fs), $0.80(mf) OTS
67246	16-30074	$2.60(fs), $0.89(mf) OTS
67939	16-29371	Dep.(mc); $2.60(fs), $0.86(mf) OTS
69432(Suppl. A)	16-29059	Dep.(mc); $1.60(fs), $0.80(mf) OTS
69586(Rev.)	16-29025	$1.60(fs), $0.80(mf) OTS
70158(Pt.I)	16-30075	Dep.; $2.25(OTS)
70880	16-30076	Dep.(mc); $4.60(fs), $1.61(mf) OTS
71083	16-30128	Dep.(mc); $2.60(fs), $0.92(mf) OTS
71953	16-29711	Dep.(mc); $3.60(fs), $1.25(mf) OTS
72048	16-30012	Dep.(mc); $4.60(fs), $1.61(mf) OTS
72097	16-30129	Dep.(mc); $2.60(fs), $0.98(mf) OTS
72778	16-30041	Preprint Paper No. 46. New York, Engineers Joint Council, 1962
73292	16-30130	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73482	16-30154	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73540	16-29315	Dep.; $4.60(fs), $1.64(mf) OTS
73600(Rev.)	16-30013	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73994	16-29101	Dep.(mc); $1.60(fs), $0.80(mf) OTS
74375	16-30155	Dep.; $1.00(OTS)
74536	16-30156	Dep.(mc); $1.60(fs), $0.80(mf) OTS
74571	16-30077	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
1911	16-29033	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1912	16-29034	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1972	16-28866	Dep.(mc); $3.60(fs), $1.40(mf) OTS
1993	16-29102	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1997	16-28698	Dep.(mc); $1.10(fs), $0.80(mf) OTS
2011	16-28889	Health Phys., 8: 407-10(1962)
2338	16-28712	Health Phys., 8: 411-21(1962)
2475	16-30046	Preprint Paper No. 74. New York, Engineers Joint Council, 1962
2478	16-30159	Preprint Paper No. 53. New York, Engineers Joint Council, 1962
2557	16-29255	Am. Ind. Hyg. Assoc. J. 23: 251-6(1962)
2637	16-29876	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2713	16-29209	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-tr–		
32	16-28704	Dep.(mc); $5.60(fs), $1.73(mf) JCL
I–		
A2049-13(Suppl.)	16-29062	See TID-11279(Suppl.)
A2049-17	16-29062	See TID-11279(Suppl.)
IA–	(Non-AEC)	
680	16-30133	Dep.(mc)
686	16-30134	Dep.(mc)
691	16-28865	Dep.(mc)
738	16-28974	Dep.(mc)
IDO–		
14590	16-29316	Dep.; $0.50(OTS)
16744	16-29753	Dep.; $0.50(OTS)
16773	16-30014	Dep.; $0.75(OTS)
16774	16-30015	Dep.; $1.50(OTS)
19022	16-30007	See CEND-108
19030(Vol.IV, Suppl.)	16-30055	See CEND-135(Vol.IV, Suppl.)
19030(Vol.VI)	16-30056	See CEND-135(Vol.VI)
19310	16-29182	Dep.(mc); $4.60(fs), $1.52(mf) OTS

Report No.	Abstract No.	Availability
IEA–	(Non-AEC)	
46	16-28867	Dep.(mc)
IS–		
212	16-29103	Dep.(mc); $1.10(fs), $0.80(mf) OTS
503	16-29372	Dep.(mc); $6.60(fs), $2.09(mf) OTS
504	16-28868	Dep.(mc); $9.60(fs), $3.65(mf) OTS
JAERI–	(Japanese)	
1018	16-30135	
1020	16-29754	
1026	16-30136	
1031	16-30137	
1032	16-30016	Dep.(mc)
6009	16-30138	
JEN–	(Spanish)	
96-DF/I-29	16-29104	Dep.(mc)
99-DQ/I-30	16-29035	Dep.(mc)
103-DF/I-31	16-30139	Dep.(mc)
107-DQ/I-33	16-28869	Dep.(mc)
JINR–	(Russian)	
D-1004	16-29636	Dep.(mc)
D-1016	16-29637	Dep.(mc)
E-983	16-29638	Dep.(mc)
P-897	16-29105	Dep.(mc)
P-989	16-29474	Dep.(mc)
P-999	16-29781	Dep.(mc)
P-1001	16-29036	Dep.(mc)
P-1011	16-29639	Dep.(mc)
JPRS–	(Non-AEC)	
13562	16-28671	OTS
13820	16-28753	OTS
13953	16-28754	OTS
14284	16-28655	OTS
14524	16-28986	OTS
14621	16-29252	$0.50(OTS)
14829	16-28675	$28.50(OTS)
14833	16-28756	OTS
14837	16-29492	OTS
14976	16-30106	OTS
15002	16-28835	OTS
K–		
1117	16-28916	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1267	16-29026	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1418	16-28870	Dep.(mc); $2.60(fs), $0.89(mf) OTS
1520	16-29712	Dep.; $0.75(OTS)
1527	16-29294	Dep.; $2.60(fs), $0.95(mf) OTS
KAPL–		
1866	16-29439	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2208	16-29085	Dep.; $2.25(OTS)
KAPL-M–		
EC-19	16-29304	$9.10(fs), $3.38(mf) OTS
LRM-2	16-29340	$1.10(fs), $0.80(mf) OTS
KFK–	(German)	
76	16-29327	Federation Proc., 20: Suppl. No. 10, 206-19 (1961)
KR–	(Norwegian)	
21	16-30017	Dep.(mc); $4.60(fs), $1.61(mf) OTS
LA–		
1721(2nd Ed.) (Rev.)	16-28871	Dep.(mc); $5.60(fs), $1.91(mf) OTS
2711	16-29475	Dep.; $0.50(OTS)
2717	16-29106	Dep.; $0.50(OTS)
2735	16-30018	Dep.; $2.75(OTS)
LADC–		
4791	16-29908	See TID-12518
5153	16-29845	Phys. Rev., 127: 1233-45(1962)
5244	16-29927	Phys. Rev., 127: 1157-62(1962)
5293	16-29828	Phys. Rev., 127: 844-54(1962)
5335	16-29832	Phys. Rev., 127: 880-904(1962)
LAMS–		
2593	16-28643	Dep.(mc); $3.60(fs), $1.37(mf) OTS
2701	16-29476	Dep.; $0.50(OTS)

Report No.	Abstract No.	Availability
2721	16-29904	Dep.; $0.50(OTS)
LAS-SR-		
161-47	16-28651	See TID-16338
LMF-	(Italian)	
62/30	16-29877	Dep.(nc)
62/62	16-29640	Dep.(nc)
MATT-Q-		
18	16-29905	Dep.; $1.00(OTS)
MCW-		
1460	16-29373	Dep.; $0.50(OTS)
MF-		
30	16-29906	See NYO-9191
MITNE-		
4	16-30147	See TID-15978
MLM-		
1125	16-28644	Dep.; $2.60(fs), $1.01(mf) OTS
MND-M-	(Misc.)	
1824	16-30078	Dep.(nc); $3.60(fs), $1.40(mf) OTS
1916	16-30079	Dep.(nc); $11.50(fs), $5.00(mf) OTS
2343	16-30080	Dep.(nc); $6.60(fs), $2.27(mf) OTS
2824	16-30081	Dep.(nc); $8.10(fs), $2.78(mf) OTS
MND-MD-		
2560-4	16-30082	Dep.; $2.50(OTS)
NA-	(Non-AEC)	
8250-8268-2	16-29379	See RADC-TDR-62-66
NAA-SR-		
4384	16-30083	Dep.; $1.00(OTS)
6905	16-29037	Dep.; $1.25(OTS)
7085	16-30150	Dep.(nc); $3.60(fs), $1.40(mf) OTS
7135	16-30084	Dep.; $0.50(OTS)
7248	16-29440	Dep.; $1.00(OTS)
7314	16-28917	Dep.; $1.60(fs), $0.80(mf) OTS
NARF-	(Non-AEC)	
62-11T	16-29612	
NASA-TM-	(Misc.)	
D-1115*	16-29641	
D-1217*	16-29060	$1.00(OTS)
D-1221*	16-29374	$2.25(OTS)
D-1322*	16-30019	$0.75(OTS)
D-1383*	16-29210	$1.00(OTS)
NDL-TR-	(Non-AEC)	
36(Vol.A)	16-29665	See UNC-5014(Vol.A)
36(Vol.B)	16-29788	See UNC-5014(Vol.B)
NEVIS-	(Misc.)	
100	16-29642	Dep.(nc); $3.60(fs), $1.28(mf) OTS
106	16-29107	Dep.(nc); $1.60(fs), $0.80(mf) OTS
NLCO-		
855	16-29027	Dep.; $2.00(OTS)
NNI-	(Misc.)	
2106	16-29375	Dep.(nc); $1.60(fs), $0.80(mf) OTS
7217	16-29353	Dep.(nc); $2.60(fs), $0.98(mf) OTS
7249	16-30085	Dep.(nc); $4.60(fs), $1.58(mf) OTS
7250	16-30086	Dep.(nc); $2.60(fs), $1.01(mf) OTS
7252	16-30087	Dep.(nc); $1.60(fs), $0.80(mf) OTS
9237*	16-29376	
NP-	(AEC File No. for Non-AEC Reports)	
11605	16-29643	Dep.(nc)
11845	16-29086	
11900	16-29644	
11901	16-29645	Dep.(nc)
11909	16-30088	Dep.(nc)
11910	16-29477	
11912	16-30089	Dep.(nc)
11922	16-30020	Dep.(nc)
11927	16-29646	
11930	16-29478	
11931	16-29878	Dep.(nc)
11935	16-29479	
11938	16-29879	
11949	16-29108	
11950(Vol.I)	16-29647	Dep.(nc)
11950(Vol.II)	16-29653	Dep.(nc)
11954	16-29109	
11955	16-29782	Dep.
11956	16-29783	Dep.
11957	16-29784	Dep.
11958	16-29963	
11960	16-28645	Dep.(nc)
11967	16-29480	
11978	16-29657	Dep.(nc)
11982	16-28834	
11987	16-29317	
11989	16-29481	
11990	16-29341	
11992	16-29658	
11994	16-29354	
11997	16-29377	
12015	16-28975	
NP-tr-	(AEC File No. for Non-AEC Translations)	
907	16-28705	Dep.(nc); $1.60(fs), $0.80(mf) JCL
NYO-		
2303	16-29305	Dep.(nc); $5.60(fs), $1.73(mf) OTS
2667	16-29110	Dep.(nc); $1.60(fs), $0.80(mf) OTS
4815	16-30090	Dep.(nc); $8.10(fs), $2.84(mf) OTS
4817	16-29211	Dep.(nc); $9.10(fs), $3.32(mf) OTS
8771	16-29295	Dep.(nc); $9.10(fs), $3.50(mf) OTS
9158	16-28978	See RRL-39
9191	16-29906	Dep.(nc); $2.60(fs), $0.83(mf) OTS
9576	16-29280	Dep.(nc); $3.60(fs), $1.25(mf) OTS
9809	16-29061	Dep.(nc); $3.60(fs), $1.37(mf) OTS
9811	16-29482	Dep.(nc); $1.10(fs), $0.80(mf) OTS
10093	16-29087	Dep.(nc); $2.60(fs), $0.92(mf) OTS
10152	16-28743	Dep.(nc); $10.10(fs), $3.95(mf) OTS
10177	16-28976	Dep.(nc); $2.60(fs), $0.89(mf) OTS
10236	16-29659	Dep.(nc); $1.60(fs), $0.80(mf) OTS
10360	16-28977	Dep.(nc); $1.10(fs), $0.80(mf) OTS
ORA-	(Misc.)	
03043-4-T	16-29486	See TID-16477
03719-2-T*	16-28599	See AFOSR-3024
ORNL-		
275	16-30143	Dep.(nc); $8.10(fs), $2.81(mf) OTS
1269	16-29296	Dep.(nc); $4.60(fs), $1.61(mf) OTS
1345	16-29880	Dep.(nc); $2.60(fs), $0.89(mf) OTS
1383	16-29881	Dep.(nc); $3.60(fs), $1.16(mf) OTS
1671	16-29111	Dep.(nc); $2.60(fs), $0.92(mf) OTS
1915	16-30091	Dep.(nc); $12.50(fs), $5.51(mf) OTS
2274(Pts.1-5)	16-28646	Dep.(nc); $19.75(fs), $9.36(mf) OTS
2340(Pts.1-5)	16-28647	Dep.(nc); $21.00(fs), $9.54(mf) OTS
2971(Vol.7)	16-29038	Dep.; $1.25(OTS)
3248	16-30140	Dep.; $2.25(OTS)
3306	16-29785	Dep.; $12.50(fs), $5.42(mf) OTS
3335	16-29281	Dep.; $1.75(OTS)
3339	16-29378	Dep.; $2.60(fs), $0.98(mf) OTS
ORNL-TM-		
95	16-29050	Preprint Paper No. 48. New York, Engineers Joint Council, 1962
131	16-29051	Preprint Paper No. 49. New York, Engineers Joint Council, 1962
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273	16-30141	Dep.(nc); $2.60(fs), $1.10(mf) OTS
274	16-30142	Dep.(nc); $2.60(fs), $0.83(mf) OTS
276	16-30144	Dep.(nc); $5.60(fs), $1.82(mf) OTS
279	16-30145	Dep.(nc); $9.60(fs), $3.71(mf) OTS
283	16-30146	Dep.(nc); $3.60(fs), $1.31(mf) OTS
291	16-30021	Dep.(nc); $1.10(fs), $0.80(mf) OTS
293	16-29342	Dep.(nc); $4.60(fs), $1.67(mf) OTS
294	16-29343	Dep.(nc); $3.60(fs), $1.16(mf) OTS
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314	16-30092	Dep.(nc); $1.60(fs), $0.80(mf) OTS
330	16-29112	Dep.(nc); $1.60(fs), $0.80(mf) OTS

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ORO–		
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577	16-29356	Dep.(mc); $11.00(fs), $4.67(mf) OTS
578	16-30022	Dep.(mc); $8.10(fs), $2.66(mf) OTS
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60-1	16-29213	Dep.(mc); $4.60(fs), $1.67(mf) OTS
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298/VII	16-29306	
305/IX	16-30023	Dep.
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3,010,887	16-30047	
3,012,542	16-30048	
3,012,729	16-29310	
3,024,364	16-29179	
PST-Cat.–	(Misc.)	
571	16-28925	See AEC-tr-4582
569-570	16-28983	See AEC-tr-4578
R–	(Misc.)	
314	16-29642	See NEVIS-100
324	16-29107	See NEVIS-106
60APE8	16-29338	See GEAP-3462
60SD330*	16-29483	
RADC-TDR–		
62-66	16-29379	
RAI–		
101	16-29039	Dep.(mc); $4.60(fs), $1.55(mf) OTS
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2899-AEC	16-29570	Phys. Rev., 127: 1182-92(1962)
3204-PR*	16-28648	
62TMP-44*	16-29473	See DASA-1291
RRL–	(Misc.)	
39	16-28978	Dep.(mc); $1.10(fs), $0.80(mf) OTS
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(62)49	16-28766	Atti assoc. genet. ital., 7: 257-65(1962)
RT-CHI–	(Italian)	
(62)4	16-30020	See NP-11922
(62)8	16-29299	Atti accad. sci. lettere ad arti Palermo, 20: 295-303(1959-60)
(62)9	16-28857	Atti accad. nazl. Lincei, Rend., Classe sci. fis., mat. e nat., 31: 427-8(1961)
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(62)7	16-30118	Tecnico ital., 27: No. 5, 3-15(1962)
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(62)2	16-29192	6p. of Boll. soc. geol. ital., 80: (1961)
(62)3	16-29191	Rend., Classe sci. fis., mat. e nat., 30: 437-48(1961)
RT-PROT–	(Italian)	
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4722(RR)	16-29183	Dep.; $0.50(OTS)
SCL-T–		
430	16-29122	Dep.(mc); $2.60(fs), $1.34(mf) JCL
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SCR–		
500	16-28649	Dep.; $1.75(OTS)
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81-59(51)	16-29907	Dep.(mc); $2.60(fs), $0.86(mf) OTS
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930(2210-02)TR-1	16-29903	See DCAS-TDR-62-112
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16020	16-29063	Dep.; $1.50(OTS)
16119	16-29660	Dep.(mc); $2.60(fs), $1.01(mf) OTS
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